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ABSTRACT

This is one of eighteen sets of individualized mathematics problems developed by the Oregon Vo-Tech Math Project. Each of these problem packages is organized around a mathematical topic and contains problems related to diverse vocations. Solutions are provided for all problems. This volume includes problems involving measurement, computation of areas and volumes from linear measurements, and conversion from one measure system to another. The problems are drawn from eleven vocational areas: marketing, construction, forestry, forest products, clerical work, wood products, welding, electronics, agriculture, drafting, industrial mechanics, and nursing. Tables of conversion are included. (SD)

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I
L INDIVIDUALIZED
LEARNING
S SYSTEMS

Individualized Math Problems in

Measurement & Conversion

Oregon Vo-Tech Mathematics Problem Sets

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Individualized Learning Systems

MATHEMATICS

Measurement & Conversions

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A. Problems with Solutions

1. A broker sold a lot 60 feet wide and 90 feet deep, at a price of 10 cents per square foot. What price was the buyer charged?

   Solution:

   Area = (length)(width)

   = (60 ft)(90 ft) = 5,400 sq ft

   Price = (5,400 ~~sq ft~~)($0.10/~~sq ft~~) = $540.00

2. A warehouse measures 150 ft by 200 ft and rents for $9,550 per year. What is the cost of a square foot of storage for a year?

   Solution:

   Find the total square footage and divide into the total yearly rent cost.

   Area = (150 ft)(200 ft) = 30,000 sq ft

   Cost per sq ft = $\frac{\$9,550/\text{year}}{30,000 \text{ sq ft}}$ = $0.318 or about $0.32 a year for a sq ft

3. The Travel Inn Motel must recarpet eight of its units. Each unit measures 14 1/4 ft by 18 1/2 ft. The carpet selected costs $8.80 a square yard installed. How much will the job cost?

   Solution:

   Find the total number of square feet in the 8 units and then convert to square yards.

   Area per unit = (14.25 ft)(18.5 ft) = 263.625 sq ft

   Total area = (263.625 sq ft/~~unit~~)(8 ~~units~~) = 2,109 sq ft

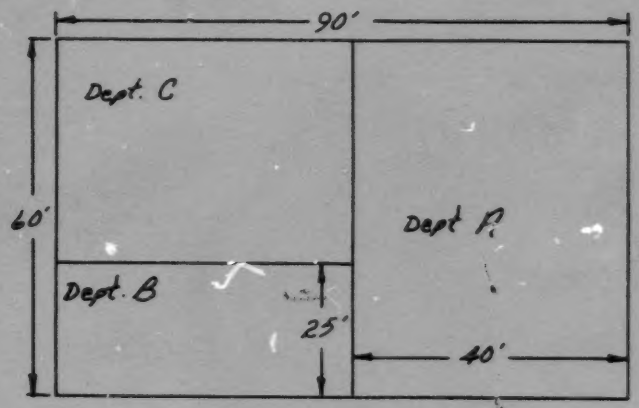
   1 sq yd = 9 sq ft, so

   2,109 sq ft = $\frac{2,109 \text{ ~~sq ft~~}}{9 \text{ ~~sq ft~~/sq yd}}$ = 234.333 sq yd

   Total cost = (234.333 ~~sq yd~~)($8.80/~~sq yd~~) = $2062.13

A. Problems with Solutions (continued)

4. Refer to the store floor plan below. If the total annual store rent is $12,000, find the annual rent to be charged each department. (i.e., fill in the blanks in the table below.)



	Sq Ft Occupied	% of Space Occupied	Annual Rent Charges
Dept A			
Dept B			
Dept C			
TOTAL			

Solution:

	Dept A	Dept B
Sq ft	(40 ft)(60 ft) = 2,400 sq ft	(25 ft)(50 ft) = 1,250 sq ft
Percent	$\frac{2{,}400 \text{ sq ft}}{5{,}400 \text{ sq ft}}$ = 44.44%	$\frac{1{,}250 \text{ sq ft}}{5{,}400 \text{ sq ft}}$ = 23.15%
Rent	(0.4444)($12,000) = $5,332.80	(0.2315)($12,000) = $2,778.00

	Dept C
Sq ft	(35 ft)(50 ft) = 1,750 sq ft
Percent	$\frac{1{,}750 \text{ sq ft}}{5{,}400 \text{ sq ft}}$ = 32.41%
Rent	(0.3241)($12,000) = $3,889.20

Total sq ft = 2,400 sq ft + 1,250 sq ft + 1,750 sq ft = 5,400 sq ft
Total percent = 44.44% + 23.15% + 32.41% = 100.00%
Total rent = $5,332.80 + $2778.00 + $3,889.20 = $12,000.00

Level 1

B. Problems without Solutions

5. Mr. Carr decided to sell 45 acres of land by sub-dividing it into 1/3 acre lots. Five acres had to be set aside for roads and right-of-ways. How many lots will he be able to sell?

Level 2

6. A service station owner is installing new equipment. He has replaced an underground cylindrical gas tank with a new one having outside dimensions of 8 ft 9 inches in diameter and 15 ft 6 in long. If his old tank held 5,000 gallons, how many more gallons will his new tank hold? (1 cu ft = 7.5 gallons.)

7. A real estate broker sold a lot with 66 ft 9 in frontage on the street and 150 ft depth to the alley. The sale price is 16¢ per sq ft. If the broker's commission is 6%, how much did he make?

B. Problems without Solutions (continued)

8. A tract of land measures 264 ft wide by 660 ft deep. How much will the tract cost at $800 per acre? (1 acre = 43,560 sq ft)

9. (a) The Crowley Construction Company was awarded a contract to build 1.18 miles of highway. How many feet is that? (to the nearest foot)

   (b) The highway is 40 feet wide. The price for the work, including fill, leveling, grading, ballasting, subsurfacing, paving, etc., amounts to $2.25 per square foot. How much is the Crowley Construction Company getting for the job?

10. A factory site in the shape of a rectangle is 250 ft long and 231 ft 6 in wide. If it is to be fenced, (a) how many rods of fencing will be required? If the wire costs $2.25 per linear rod and only whole rods may be purchased, (b) what will be the cost of the wire? (1 rod = 16.5 ft)

B. Problems without Solutions (continued)

11. A street 960 ft long and 40 ft wide is to be paved with concrete to a depth of 6 in. (a) How many cubic yards of concrete will be used? (b) What will it cost at $15.50 per cu yd? (Assume a fraction of a cubic yard to cost the same as an entire cubic yard.)

12. A realty investment club purchased a 6 1/2 acre commercially zoned piece of property for 35¢ per square foot. How many acres of the property must the club sell at $1.00 per square foot to get back their original investment?

13. The lot is a triangular parcel with the length of the longest side 100 feet and the depth from its deepest point to the base or longest side is 40 feet. If the price per square foot is 12 cents, what price would be charged?

B. Problems without Solutions (continued)

14. The tax on a piece of property which measured 213 x 250 feet was $51.31. What are the taxes on a 17 by 250 foot strip at the same rate?

15. A company packed its fish in cans containing 12 ounces net weight. Each can weighed one ounce. Two dozen cans were packed in a carton which weighed 8 ounces. A customer ordered 64 dozen cans. What was the total weight of his shipment? (in pounds)

Complete Solutions to B Problems

5. Acres to be divided into lots = 45 acres - 5 acres = 40 acres

$$\text{Lots to sell} = \frac{40 \text{ acres}}{1/3 \text{ acre/lot}} = (40)(3 \text{ lots}) = 120 \text{ lots}$$

6. Need to find the volume in cubic feet of the new tank, then, find how many gallons it holds and compare the volume of the new tank with the volume of the old tank.

Volume = $\pi r^2 h$ ($\pi = 3.14$)

r = radius h = height or length

$$r = \frac{8 \text{ ft } 9 \text{ in}}{2} = \frac{8.75 \text{ ft}}{2} = 4.375 \text{ ft}$$

h = 15.5 ft

Volume = $(3.14)(4.375 \text{ ft})^2 (15.5 \text{ ft})$

= 931.57 cu ft

= 932 cu ft to the nearest cubic foot

Total gallons = (932 ~~cu ft~~)(7.5 gal/~~cu ft~~)

= 6,990 gallons

Difference = 6,990 gals - 5,000 gals = 1,990 gals

The new tank holds 1,990 gallons more than the old tank.

7. Sales price = (66.75 ft)(150 ft)($0.16/sq ft)

= (10,012.5 ~~sq ft~~)($0.16/~~sq ft~~)

= $1,602

Commission = ($1,602)(0.06) = $96.12

Complete Solutions to B Problems (continued)

8. Total acreage = $\frac{\text{square footage}}{43{,}560 \text{ sq ft/acre}}$

$= \frac{(264 \text{ ft})(660 \text{ ft})}{43{,}560 \text{ sq ft/acre}}$

$= \frac{174{,}240 \text{ sq ft}}{43{,}560 \text{ sq ft/acre}}$

= 4 acres

Total cost = (4 ~~acres~~)($800/~~acre~~) = $3,200

9. (a) Total feet = (5,280 ft/~~mi~~)(1.18 ~~mi~~)

= 6,230 ft (nearest foot)

(b) Total cost = (square footage)($2.25/sq ft)

= (6,230 ft)(40 ft)($2.25/sq ft)

= (249,200 ~~sq ft~~)($2.25/~~sq ft~~)

= $560,700

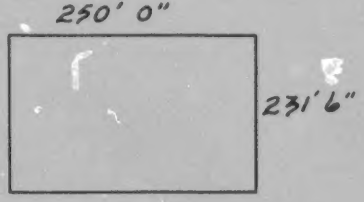
10. (a) Get the perimeter of the site in feet, then convert to rods:

Perimeter = (2 ~~sides~~)(250 ft/~~side~~) + (2 ~~sides~~)(231.5 ft/~~side~~)

= 500 ft + 463 ft = 963 ft

963 ft = $\frac{963 \text{ ft}}{16.5 \text{ ft/rod}}$ = 58.4 rods

59 rods of fencing are required



(b) Cost = (59 rods)($2.25/rod) = $132.75

11. (a) 1 cubic yard = (3 ft)(3 ft)(3 ft) = 27 cu ft

So, find total cubic feet and convert to cubic yards

Cubic feet = (960 ft)(40 ft)(0.5 ft)

= 19,200 cu ft

Complete Solutions to B Problems (continued)

11. (continued)

$$\text{Concrete} = \frac{19{,}200 \text{ cu ft}}{27 \text{ cu ft/cu yd}} = 711.1 \text{ cu yd}$$

(b) Need to order a full cubic yard in order to get the 0.1 cubic yard.

Cost = (712 cu yds)($15.50/cu yd)

= $11,036.00

12. Total square footage = (6.5 acres)(43,560 sq ft/acre)

= 283,140 sq ft

Original cost = (283,140 sq ft)($0.35/sq ft) = $99,099

The club must sell 99,099 sq ft at $1.00 per sq ft in order to recover their investment.

$$\text{Property that must be sold} = \frac{99{,}099 \text{ sq ft}}{43{,}560 \text{ sq ft/acre}} = 2.275 \text{ acres}$$

13. Area of parcel = (1/2)(base)(height)

= (0.5)(100 ft)(40 ft) = 2,000 sq ft

Selling price = (2,000 sq ft)($0.12/sq ft) = $240.00

14. $$\text{Tax rate on 213' by 250' lot} = \frac{\$51.31}{(213 \text{ ft})(250 \text{ ft})} = \frac{\$51.31}{53{,}250 \text{ sq ft}}$$

Thus, on the 17' by 250' strip:

Total tax = (tax rate)(square footage)

$$= \left(\frac{\$51.31}{53{,}250 \text{ sq ft}}\right)(17 \text{ ft})(250 \text{ ft})$$

$$= \frac{(\$51.31)(4{,}250 \text{ sq ft})}{53{,}250 \text{ sq ft}} = \frac{\$218{,}067.50}{53{,}250}$$

= $4.10 (use a calculator and don't round the intermediate results.)

Complete Solutions to B Problems (continued)

15. Total weight = weight of fish + weight of cans + weight of boxes

$$= (12 \text{ oz/can})(12 \text{ cans/doz})(64 \text{ doz}) + (1 \text{ oz/can})(12 \text{ cans/doz})(64 \text{ doz}) + (8 \text{ oz/box})\left(\frac{64 \text{ doz}}{2 \text{ doz/box}}\right)$$

$$= 9{,}216 \text{ oz} + 768 \text{ oz} + 256 \text{ oz}$$

$$= 10{,}240 \text{ oz}$$

$$10{,}240 \text{ oz} = \frac{10{,}240 \text{ oz}}{16 \text{ oz/lb}} = 640 \text{ lbs}$$

Total weight = 640 pounds

A. Problems with Solutions

1. Determine the board feet of 1 inch sub-flooring needed for floor plan A.

When determining the amount of sub-flooring needed, the following information is needed:

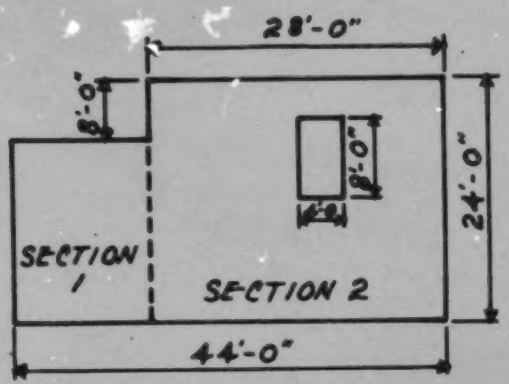
(a) Total area to be covered.

(b) Square footage of floor openings.

(c) Whether sub-flooring is straight or diagonal.

(d) Waste allowance at 30% for diagonal and 20% for straight.

Note: Board feet equals the number of square feet of 1-inch board.



PLAN A

Solution:

Total area = area (section 1) + area (section 2) - area of floor opening

Area = (length)(width)

Area (section 1) = (44' - 28')(24' - 8')
= (16')(16')
= 256 sq ft

Area (section 2) = (28')(24')
= 672 sq ft

Then, subtract the area of the floor opening

Area of floor opening = (8')(4')
= 32 sq ft

A. Problems with Solutions (continued)

1. (continued)

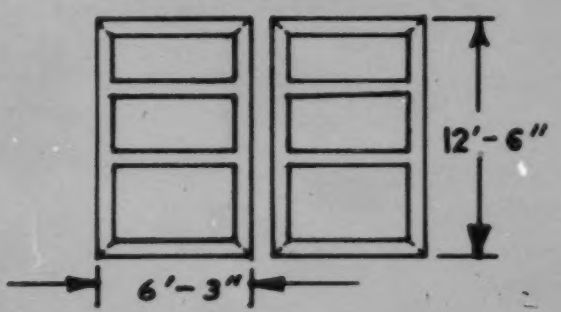
Total area = 256 sq ft + 672 sq ft - 32 sq ft
= 896 sq ft

So, the amount of sub-flooring needed if you lay it straight
(assuming 20% waste) = 896 sq ft + (20%)(896 sq ft)
= 896 sq ft + (0.20)(896 sq ft)
= 896 sq ft + 179.2 sq ft
= 1,075.20 sq ft
Since this is 1" flooring, 1,075.20 sq ft = 1,075.20 board feet.

The amount of sub-flooring needed if you lay it diagonally
(assuming 30% waste) = 896 sq ft + (30%)(896 sq ft)
= 896 sq ft + (0.30)(896 sq ft)
= 896 sq ft + 268.8 sq ft
= 1,164.8 sq ft
Since this is 1" flooring 1,164.80 sq ft = 1,164.80 board feet.

B. Problems without Solutions

2. How many linear feet of 2" x 6" will be needed to frame the sliding door as shown?



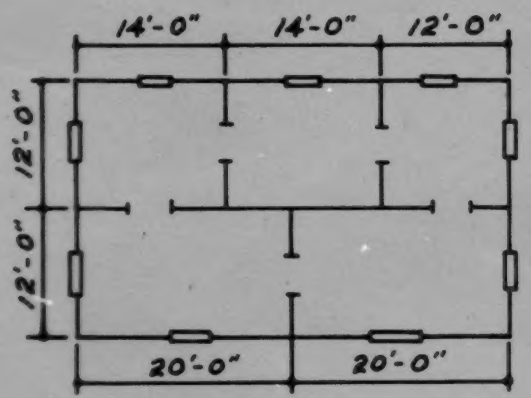
How many 14-feet pieces would be needed?
How many board feet would this be?
If 2" x 6" cost $150 per thousand, how much would these 14-feet pieces cost?
Note: One board foot equals the volume of a board 12" x 12" x 1"
or $\frac{\text{(size)(linear feet)}}{12}$

B. Problems without Solutions (continued)

2. (continued)

3. Determine the board feet of studs needed for plan C. Figure for 2" x 4" x 8' studs, and for 2" x 4" x 10' studs. Ignore the doors (i.e., assume a stud where the door is).

   Estimators have found that by allowing one stud for each lineal foot of wall no extra allowance need be made for trimmer and corner studs.



PLAN C

B. Problems without Solutions (continued)

3. (continued)

4. The proportion of cement, sand and rock will vary according to the richness of mix desired and size of rock used. A mix proportion is written as 1 : 3 : 4, meaning 1 part cement, 3 parts sand, and 4 parts rock. Cement is sometimes estimated by the barrel (4 cu ft or 4 sacks).

PROPORTIONS PER 1 CUBIC YARD DRY MIX

Mix	Cement (barrels)	Sand Cu Yd	Rock Cu Yd
1: 1 1/2: 3	1.91	0.42	0.85
1: 2: 3	1.74	0.52	0.77
1: 2: 4	1.51	0.42	0.89
1: 2 1/2: 4	1.39	0.51	0.82
1: 2 1/2: 5	1.24	0.46	0.92
1: 3: 6	1.06	0.47	0.94

1 barrel cement = 4 sacks
1 cu yd sand = 2600 lbs
1 cu yd rock = 2700 lbs
1 cu yd (27 cu ft) dry mix = approximately 22 cu ft wet mix

List the materials for 5 cu yds of 1: 2 1/2: 5 mix.

B. Problems without Solutions (continued)

4. (continued)

Complete Solutions to B Problems

2. From the figure, you need 4 boards 12' 6" long needs 4 14' boards
4 boards 6' 3" long needs 2 14' boards
4 boards 5' 3" long needs 2 14' boards
8 14' boards

Volume = (length)(width)(thickness)

Since 1 board foot equals the volume in a board 12" x 12" x 1" = 144 cu in

8 pieces 2" x 6" x 14' = 2" x 6" x 168" = 2016 cu in

Total volume = (8)(2016 cu in) = 16,128 cu in

Converting, $\frac{16{,}128 \text{ cu in}}{144 \text{ cu in/board ft}}$ = 112 board ft

Cost = (112 board ft)($150/1000 board ft) = $16.80

3. Total linear feet of wall = linear feet of perimeter + linear feet of partition

Linear feet of perimeter = 14' + 14' + 12' + 12' + 12" + 20" + 20' + 12' + 12' = 128 feet

Linear feet of partition = 14' + 14' + 12' + 12' + 12' + 12' = 76 feet

Total linear feet of wall = 128' + 76' = 204 feet

So, (204 ft)(1 stud/ft) = 204 studs

204 studs @ 2" x 4" x 8' = 2" x 4" x 96"
= 768 cu in

Total volume = (204 studs)(768 cu in/stud) = 156,672 cu in

Converting, $\frac{156{,}672 \text{ cu in}}{144 \text{ cu in/board ft}}$ = 1,088 board ft

Volume = (length)(width)(height)

204 studs @ 2" x 4" x 10' = 2" x 4" x 120"
= 960 cu in

Total volume = (204 studs)(960 cu in/stud) = 195,840 cu in

Converting, $\frac{195{,}840 \text{ cu in}}{144 \text{ cu in/board ft}}$ = 1,360 board ft

Complete Solutions to B Problems (continued)

4. From the table,

1 cu yd 1: 2 1/2: 5 Dry mix requires 1.24 barrels cement,
0.46 cu yds sand
0.92 cu yds rock

Cement: (1.24 ~~barrels~~)(4 sacks/~~barrel~~) = 4.96 sacks
Sand: (0.46 ~~cu yds~~)(2600 lbs/~~cu yd~~) = 1,196 lbs
Rock: (0.92 ~~cu yds~~)(2700 lbs/~~cu yd~~) = 2,484 lbs

If it requires this much for 1 cu yd, it requires 5 times as much for 5 cu yds.

Cement: (5)(4.96 sacks) = 24.8 sacks so, 25 sacks
Sand: (5)(1196 lbs) = 5,980 lbs
Rock: (5)(2484 lbs) = 12,420 lbs

A. Problems with Solutions

1. Setting up a proportion is a convenient method of measuring actual distances from a map scale. Use the following conversions: 1 chain = 66 feet; 5,280 feet = 1 mile.

   a) The scale on a map is 1 in = 50 ft. If two points are 3 1/2 in apart on the map, what is the actual distance between the two points?
   b) The scale on a map is 1 in = 8 chains. If two stations are known to be 1 mile apart, what distance would separate them on the map?
   c) If the scale on a map is 4 in per mile, how many feet would separate two locations that are 2 1/2 inches apart on a map?
   d) Given the scale 0.5 in = 5 miles. Two locations that are separated by 2.25 in on the map are actually how far apart?

   Solution:

   a) $\frac{1 \text{ in}}{50 \text{ ft}} = \frac{3\ 1/2 \text{ in}}{N}$ $\quad N \text{ in} = 175 \text{ ft in}$
   $N = 175 \text{ ft}$

   b) (1 mi)(5,280 ft/mi)(1 chain/66 ft) = 80 chains

   $\frac{1 \text{ in}}{8 \text{ ch}} = \frac{N}{80 \text{ ch}}$ $\quad 8N \text{ ch} = 80 \text{ ch in}$

   $N = \frac{80 \cancel{\text{ch}} \text{ in}}{8 \cancel{\text{ch}}} = 10 \text{ in}$

   c) $\frac{4 \text{ in}}{5{,}280 \text{ ft}} = \frac{2.5 \text{ in}}{N}$ $\quad 4N \text{ in} = 13{,}200 \text{ ft in}$

   $N = \frac{13{,}200 \text{ ft } \cancel{\text{in}}}{4 \cancel{\text{in}}} = 3{,}300 \text{ ft}$

   d) $\frac{0.5 \text{ in}}{5 \text{ mi}} = \frac{2.25 \text{ in}}{N}$ $\quad (0.5)N \text{ in} = 11.25 \text{ mi in}$

   $N = \frac{11.25 \text{ mi } \cancel{\text{in}}}{0.5 \cancel{\text{in}}} = 22.5 \text{ mi}$

B. Problems without solutions:

2. Units of length: 66 ft= 1 chain
5280 ft= 1 mile
5 chains = 1 tally

Using the above conversions solve the following:

a) Timberland is often sampled by running a 20 chain line across a portion of land. How many feet of line would this be? How many miles?

b) In clearing a firebreak through timber it will be 99 feet wide and 5 miles long. How many chains in width and length would this clearing be?

c) In pacing a burned area you find that it is .5 tally wide and 4 Tallies long. What is the width and length in chains? In feet?

3. A standard metric stud size is .85dm (decimeters) by .38dm.

a) Convert these dimensions to inches by using the conversions:

2.54 cm = 1 in.
10 cm = 1 dm.

b) Using the same conversion factors, convert lumber of dimensions 1 5/8 in by 3/4 in. to metric measure.

Complete solutions to B problems.

2. Solutions:

a) (20 chains) (66 feet/chains) = 1320 feet

(1320 feet) (1 mile/5280ft) = .25 mile

b) (99 feet) (1 ch/66 ft) = 1.5 ch

(5 miles) (5280ft/miles) (1 ch/66ft) = 400ch

c) (.5 tally) (5 chains/ 1 tally) = 2.5ch, then

(2.5 ch) (66ft/chain) = 165 feet

(4 tallies) (5 chains/ 1 tally) = 20 chain, then

(20 chain) (66ft/ chain) = 1320 feet

3. Solution:

a) (.85dm) (10 cm/1dm) (1 in/2.54 cm) 3 1/3 in.

(.38 dm) (10 cm/ dm) (1 in/2.54 cm) 1 1/2 in.

b) 1 5/8 in. = 1.625 in and 3/4 in = .75 in

so, (1.625 in) (2.54 cm/in) (1dm/10cm) = .41dm

(.75 in) (2.54 cm/in) (1dm/ 10 cm) = .19dm

A. Problems with Solutions

1. A technician is asked to lay off a line which is 1 talley, 3 chains, and ten links in length with a 200.0 foot tape which is 0.05 feet too short. What distance should he measure? Express your answer in feet, rounded to the nearest tenth.
Note: 1 talley = 5 chains, 1 chain = 66 ft = 100 links

Solution:

Let T be the length of line in feet, and M be the distance to be measured with the faulty tape.

T = (1 talley + 3 chains + 10 links)(66 ft/chain)
= (5 chains + 3 chains + 0.1 chain)(66 ft/chain)
= (8.1 chains)(66ft/chain)
= 534.6 feet

$$M = \frac{(200.0 \text{ ft})(534.6 \text{ ft})}{199.95 \text{ ft}} = 534.73 \text{ ft}$$

2. A topographic abney is used in measuring the height of a tree. The readings at a distance of two chains from the tree are -3 and +67. Determine the height of the tree.
Note: The topographic abney is the official hand level for timber survey work performed by the Forest Service and is normally used in conjunction with a 2-chain trailer tape. One chain = 66 ft. A reading of -5 at a distance of one chain from a point indicates the point is 5 ft lower in elevation than the abney.

Solution:

The elevation in feet from the abney to the base of the tree is (-3)(distance in chains) = (-3)(2) = -6

So the base is 6 feet below the abney.

The elevation in feet from the abney to the top of the tree is (67)(2) = 134.

So the top is 134 feet above the abney.

Height of tree = 134 feet + 6 feet = 140 ft

B. Problems without Solutions

3. A percent abney is used to measure the height of a tree. Readings taken 100 ft from the tree are +5 to the base and +75 to the top of the tree. Determine the tree's height.

4. Determine the acreage defined by the following legal Descriptions:

   a) NE $\frac{1}{4}$ of NE $\frac{1}{4}$ of NE $\frac{1}{4}$ of SE $\frac{1}{4}$ of Sec 10, T5N, R2E

   b) SE $\frac{1}{2}$ of NW $\frac{1}{4}$ of NW $\frac{1}{4}$ of SW $\frac{1}{4}$ of Sec 20

5. Determine the number of acres defined by the following legal descriptions:

   a) S $\frac{1}{2}$ of SW $\frac{1}{4}$ of NE $\frac{1}{4}$ Sec 6, T6N, R6E

   b) W $\frac{1}{2}$ of NW $\frac{1}{4}$ of SW $\frac{1}{4}$ of SE $\frac{1}{4}$ Sec 5, T6N, R4E

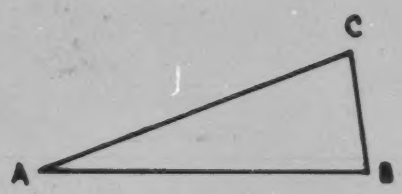
6. A forester strip cruises a 40 acre tract and obtains a 20% sample. a) How many acres does he sample? b) How many lineal chains does he travel if the strips are one chain wide?

B. Problems without Solutions

7. A line whose true length is 975.4 feet is laid off by measuring 976.2 feet with a 100.0 foot tape. Is the true length of the tape used more or less than 100.0 ft and what is the error in the tape length?

8. A fire lookout reports a forest fire of approximately square shape and 2 1/2 acres in area. a) How much fireline would be required to contain the fire if it did not increase further in size? Hint - How many square chains in 2 1/2 acres? b) If the fireline required to finally control the fire was 170 chains in length (and approximately square in shape), how many acres were enclosed by the fireline?

9. Given: The sum of the interior angles of a triangle is 180 degrees. In the triangle below, angle A = 17°55'23", angle B = 89°13'47". Determine the size of angle C. Check your answer.



B. Problems without Solutions

10. Determine the straight-line distance from the NE corner of Section 4 to the SW corner of Section 20 in the same township. Note: Sections in a township are numbered in the order shown below.

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Complete Solutions to B Problems

3. Elevation from the abney to the base of the tree = (distance)(reading in percent)
= (100 ft)(5%)
= 5 ft

Elevation from the abney to the base of the tree = (distance)(reading in percent)
= (100 ft)(75%)
= 75 ft

Height of tree = 75 ft - 5 ft = 70 ft
or equivalently = (100 ft)(0.75 - 0.05)
= 70 ft

4. 1 section = 640 acres

a) SE 1/4 = 160 acres
NE 1/4 of SE 1/4 = 40 acres
NE 1/4 of NE 1/4 of SE 1/4 = 10 acres
NE 1/4 of NE 1/4 of NE 1/4 of SE 1/4 = 2.5 acres

b) SW 1/4 = 160 acres
NW 1/4 of SW 1/4 = 40 acres
NW 1/4 of NW 1/4 of SW 1/4 = 10 acres
SE 1/2 of NW 1/4 of NW 1/4 of SW 1/4 = 5 acres

5. 1 section = 640 acres

NE 1/4 = 160 acres
SW 1/4 = 40 acres
S 1/2 = 20 acres

SE 1/4 = 160 acres
SW 1/4 = 40 acres
NW 1/4 = 10 acres
W 1/2 = 5 acres

6. Number of acres = (20%)(40 acres) = (0.2)(40 acres) = 8 acres

1 acre = 10 sq ch

(8 acres)(10 sq ch/acre) = 80 sq ch

$\frac{80 \text{ sq ch}}{1 \text{ ch}}$ = 80 chains

Complete Solutions to B Problems (continued)

7. The tape is shorter than 100 feet since the measured distance is greater than the correct distance. The percent error in the measurement is the same as the percent error in the tape, hence

$$\frac{975.4 \text{ ft}}{976.2 \text{ ft}} = \frac{\text{Tape length}}{100 \text{ ft}}$$

Tape length = 99.92 ft
Error = 100.0 ft - 99.92 ft
= 0.08 ft

8. 1 acre = 10 sq ch

Area = (2.5 acres)(10 sq ch/acre) = 25 sq ch

Perimeter = $4\sqrt{25 \text{ sq ch}}$ = 20 chains

Total area enclosed = $\left(\frac{170}{4} \text{ chains}\right)^2$ = 1,806.3 sq ch = 180.6 acres

9. Angle C = 180° - (Angle A + Angle B)
= 180° - (17°55'23" + 89°13'47")
= 180° - 106°68'70"
= 180° - 107°9'10"
= 179°59'60" - 107°9'10"
= 72°50'50"

10. By the Pythagorean Theorem

$$d = \sqrt{a^2 + b^2}$$
$$= \sqrt{4^2 + 2^2}$$
$$= \sqrt{20 \text{ sq miles}}$$
= 4.47 miles

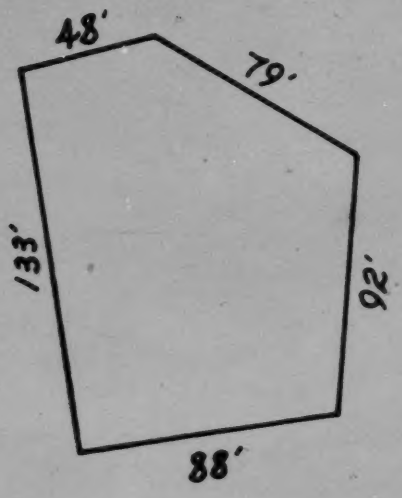
A. Problems with Solutions

1. The Milton Hotel wishes to carpet the lobby. It is 38 1/2 ft long and 31 ft wide. How many square yards of carpet will be needed?

Solution:

Area = (38.5 ft)(31 ft) = 1,193.5 sq ft
There are 9 sq ft per sq yd
$\frac{1{,}193.5 \text{ sq ft}}{9 \text{ sq ft/sq yd}}$ = 132.61 sq yds

2. An irregularly-shaped lot (see figure below) has the following dimensions: 88 feet, 133 feet, 48 feet, 79 feet, and 92 feet. What is the perimeter of this lot? (perimeter is the distance around). Give your answer in feet, then in yards.



Solution:

Perimeter = 88 ft + 133 ft + 48 ft + 79 ft + 92 ft = 440 ft
or = $\frac{440 \text{ ft}}{3 \text{ ft/yd}}$ = 146 2/3 yds

3. To 7 gallons and 3 quarts of a liquid, 4 gallons of the liquid are added. How many pint cans would the total quantity fill?

Solution:

7 gals + 3 qts + 4 gals = 11 gals + 3 qts
11 gals + 3 qts = (11 gals)(8 pts/gal) + (3 qts)(2 pts/qt)
= 88 pts + 6 pts = 94 pts

A. Problems with Solutions (continued)

4. A triangular piece of land has a frontage of 150 ft. If the area is 9,000 sq ft, what is the depth in feet?

Solution:

$$\text{Area} = (1/2)(\text{depth})(\text{frontage})$$
$$9{,}000 \text{ sq ft} = (0.5)(150 \text{ ft})(\text{depth})$$
$$\frac{9{,}000 \text{ sq ft}}{75 \text{ ft}} = \text{depth}$$
$$120 \text{ ft} = \text{depth}$$

5. A pipe line carrying oil has an inside diameter of 24.0 in. If the oil moves 3.00 miles a day, how many gallons of oil are delivered daily?

Solution:

We need the volume in gallons of a cylinder 3 miles long and 12 inches in radius. 1 gallon = 231 cubic inches.

$$V = \pi r^2 h$$
$$V = (3.14)(12 \text{ in})(12 \text{ in})(5{,}280 \cancel{\text{ft}}/\text{mile})(3 \text{ miles})(12 \text{ in}/\cancel{\text{ft}})$$
$$= 85{,}946{,}572.8 \text{ cu in}$$
$$\text{Gallons} = \frac{85{,}946{,}572.8 \cancel{\text{cu in}}}{231 \cancel{\text{cu in}}/\text{gal}} = 372{,}063.0857 \text{ gals}$$

B. Problems without Solutions

6. Battered by a hurricane, Captain Fazio Poletti reroutes the freighter Cavour, destination Naples, to land at Miami. There, his cargo of 15,000 bags of coffee, each weighing 40 kilograms, is sold at 27¢ per pound. What did Captain Poletti get for the coffee?

   Solution:

7. Velvet ribbon is sold by the inch. Sales figures show that 441 running inches were sold last week. How many yards were sold?

   Solution:

8. A railroad gets a right-of-way for 3,025 feet through Green's land. The width of the right-of-way is 72 feet. How much would Green receive for the land at the rate of $365 an acre?

   Solution:

9. It takes 17" of wire to fasten a certain type of bundle before it is packed for shipping. If 175 of these bundles are prepared for shipping each day, how many yards of wire are needed each day?

   Solution:

B. Problems without Solutions (continued)

10. The flat top of a large cylindrical water tank is to be repainted. If two coats are necessary, how many gallons of paint must be purchased if the diameter is 80 ft and it is estimated 1 gal of paint will cover 450 sq ft? (Let π = 3 1/7) Assume that only whole gallons are purchased.

Solution:

11. Picture frame molding is sold by the linear foot. A customer selects a type which is priced at 79¢ a foot. He purchases 4 pieces 18" long, 8 pieces 14" long, 8 pieces 9" long and 4 pieces 15" long. How much should he be charged?

Solution:

12. Harry's Grocery must replace the sidewalk in front of the store. The walk is 65 ft long by 6' 4" wide. If the contractor charges 58¢ per sq ft, how much will the job cost?

Solution:

13. Calculate the cubic foot of storage in a bin which has inside measurements of 2 1/2 ft by 3 5/8 ft by 5 1/4 ft.

Solution:

B. Problems without Solutions (continued)

14. A ranch in the shape of a rectangle is exactly 2 miles wide and 3 miles, 15 rods long. Find the area in acres.

Solution:

15. If 90 ft is the depth of a triangular piece of land and its area is 13,500 sq ft, what is the length of the frontage in feet?

Solution:

16. Dewey Rankin, farmer, leveled and banked an area for a fish farm 220 by 198 feet and filled it with water from his irrigation allotment to a height of 4 feet. How many acre-feet of water did he use?

Solution:

17. One seed company recommends that a pound of grass seed be used for every 1,000 sq ft of surface area in seeding a new lawn. What is the cost of seeding a lot 70 ft by 100 ft if the house on it is 27 ft by 37 ft, and the seed cost 30¢ a pound?

Solution:

B. Problems without Solutions (continued)

18. How many cubic yards of dirt must be removed from a basement excavation which measures 35 ft wide, 46 ft long and 14 ft deep?

Solution:

19. A circular stage is to be covered with hardwood flooring. If the circumference is 235.62 ft, what will be the cost at 28¢ per sq ft or fraction thereof?

Solution:

20. A painting contractor is hired to paint the walls of three rooms. Two of the rooms measure 11 ft wide by 14 ft long. The third room is 12 ft wide by 15 ft long. The walls are all 8 ft high. If a gallon of paint covers approximately 400 sq ft, how much paint will be needed to complete the job? (disregard doors, windows, etc.)

Solution:

Complete Solutions to B Problems

6. 1 lb = 0.4536 Kilograms

(15,000 bags)(40 Kg/bag) = 600,000 Kg

$\frac{600{,}000 \text{ kg}}{0.4536 \text{ kg/lb}} = 1{,}322{,}751.32 \text{ lbs}$

(1,322,751.32 lbs)($0.27/lb) = $357,142.86

7. $\frac{441 \text{ in}}{36 \text{ in/yd}} = 12.25 \text{ yards}$

8. There are 43,560 square feet per acre

(3,025 ft)(72 ft) = 217,800 sq ft

$\left(\frac{217{,}800 \text{ sq ft}}{43{,}560 \text{ sq ft/acre}}\right)$ ($365/acre) = $1,825

9. Total wire needed = (17 in/bundle)(175 bundles) = 2,975 in or

$= \frac{2{,}975 \text{ in}}{36 \text{ in/yds}} = 82.6 \text{ yards}$

10. Area of top = πr^2

= (3 1/7)(40 ft)(40 ft)

= (3.14)(1,600 sq ft) = 5,024 sq ft

Gallons needed = $\frac{(5{,}024 \text{ sq ft/coat})(2 \text{ coats})}{450 \text{ sq ft/gallon}}$ = 23 gallons

11. Total length = (4 pieces)(18 in/piece) + (8 pieces)(14 in/piece) +

(8 pieces)(9 in/piece) + (4 pieces)(15 in/piece)

= 72 in + 112 in + 72 in + 60 in = 316 in = 26 1/3 ft

Cost = (26 1/3 ft)($0.79/ft) = $20.80

12. Cost = (length)(width)(price per sq ft)

= (65 ft)(19/3 ft)($0.58/sq ft)

$= \left(\frac{1235}{3} \text{ sq ft}\right)$ ($0.58/sq ft)

$= \frac{\$716.30}{3} = \$238.77$

13. Volume = (length)(width)(height)

= (2 1/2 ft)(3 5/8 ft)(5 1/4 ft)

= (5/2 ft)(29/8 ft)(21/4 ft)

$= \frac{3045}{64}$ cu ft = 47 37/64 cu ft

Complete Solutions to B Problems (continued)

14. 1 rod = 5 1/2 yards = 16 1/2 ft 1 sq mile = 640 acres

$$15 \text{ rods} = (15 \text{ rods})(16.5 \text{ ft/rod})\left(\frac{1 \text{ mile}}{5{,}280 \text{ ft}}\right)$$

$$= (247.5 \text{ ft})\left(\frac{1 \text{ mile}}{5{,}280 \text{ ft}}\right) = 0.046875 \text{ miles}$$

Area = (2 miles)(3.046875 miles)(640 acres/sq miles)
= 3,900 acres

15. Area of triangle = (1/2)(base)(height)
13,500 sq ft = (1/2)(90 ft)(height)

$$\frac{13{,}500 \text{ sq ft}}{45 \text{ ft}} = \text{height}$$

300 ft = height

16. 1 acre = 43,560 sq ft
Area = (220 ft)(198 ft) = 43,560 sq ft = 1 acre
(1 acre)(4 ft) = 4 acre-feet of water

17. Lot area = (70 ft)(100 ft) = 7,000 sq ft
House area = (27 ft)(37 ft) = 999 sq ft
Seeding area = 7,000 sq ft - 999 sq ft = 6,001 sq ft

$$\text{Cost} = \left(\frac{6{,}001 \text{ sq ft}}{1{,}000 \text{ sq ft/lb}}\right)(\$0.30/\text{lb})$$

= (6.001 lb)($0.30/lb) = $1.80

18. Volume = (length)(width)(height)
= (35 ft)(46 ft)(14 ft)
= 22,540 cu ft

$$\text{Volume} = \frac{22{,}540 \text{ cu ft}}{27 \text{ cu ft/cu yd}} = 834.81 \text{ cu yards}$$

Therefore 835 cu yards of dirt must be removed

19. Circumference = (π) (diameter)
C = (3.1416)(d)
235.62 ft = (3.1416)(d)

$$\frac{235.62 \text{ ft}}{3.1416} = d$$

75 ft = d

$$\text{Area} = \frac{\pi d^2}{4}$$

$$= \frac{(3.1416)(75 \text{ ft})(75 \text{ ft})}{4}$$

$$= \frac{17{,}671.5 \text{ sq ft}}{4}$$

= 4,417.9 sq ft
Cost = (4,417.9 sq ft)($0.28/sq ft)
= $1,237.01

Complete Solutions to B Problems (continued)

20. Total area = (4)(11 ft)(8 ft) + (4)(14 ft)(8 ft) + (2)(12 ft)(8 ft) + (2)(15 ft)(8 ft)
= 352 sq ft + 448 sq ft + 192 sq ft + 240 sq ft
= 1,232 sq ft

Paint needed = $\frac{1{,}232 \text{ sq ft}}{400 \text{ sq ft/gal}}$ = 3.08 gallons

B. Problems without solutions.

1. An order for 66 pieces of 4' x 8' panels of 1/2 inch plywood is being prepared for shipment and the volume of the material must be determined. Compute the total volume of the order.

Total thickness = (number of boards) (thickness per board)

For 1/4" panels = (number of boards) $\left(1/4 \frac{\text{in}}{\text{board}}\right)$

3/8" panels = (number of boards) $\left(3/8 \frac{\text{in}}{\text{board}}\right)$

1/2" panels = (number of boards) $\left(1/2 \frac{\text{in}}{\text{board}}\right)$

3/4" panels = (number of boards) $\left(3/4 \frac{\text{in}}{\text{board}}\right)$

Cubic inches = (surface area of a panel)(total thickness)

$$\text{Cubic feet} = \frac{\text{(cubic inches)}}{1728 \frac{\text{cu in}}{\text{cu ft}}}$$

Definition : Surface area of a panel is the product of the width and the length .

Complete solution to B problem.

1. Total thickness = (number of boards) (thickness per board)

= (66 panels) $\left(1/2 \frac{\text{in}}{\text{panel}}\right)$

= 33 inches.

Surface Area = 4' x 8'

= 48" x 96 "

= 4608 sq inches

Cubic inches = (4608 sq inches)(33")

= 152,064 cubic inches

Cubic feet = $\frac{152064 \text{ cubic inches}}{1{,}728 \frac{\text{cubic inches}}{\text{cubic foot}}}$ = 88 cubic feet

A. Problems with Solutions

1. Convert each of the following measurements to feet and inches rounding to the nearest 1/4" or nearest 1/2.

(a) 6.3'

(b) 4.27'

(c) .39'

(d) 1.09'

(e) .088'

(f) 4.11'

(g) .89"

(h) 2.33"

Solution:

0" or greater but less than .125" rounds to 0".
.125" or greater but less than .375" rounds to 1/4".
.375" or greater but less than .625" rounds to 1/2".
.625" or greater but less than .875" rounds to 3/4".
.875" or greater rounds to 1".

(a) .3 x 12 = 3.6 therefore 5.3' = 6' 3 1/2" rounded

(b) .27 x 12 = 3.24 therefore 4.27' = 4' 3 1/4" rounded

(c) .39 x 12 = 4.68 therefore .39' = 4 3/4" rounded

(d) .09 x 12 = 1.08 therefore 1.09' = 1' 1" rounded

(e) .088 x 12 = 1.056 therefore .088' = 1" rounded

(f) .11 x 12 = 1.32 therefore 4.11' = 4' 1 1/4" rounded

(g) .89" = 1" rounded

(h) 2.33" = 2 1/4" rounded

A. Problems with Solutions (continued)

2. A square foot of an 8 gauge hot rolled steel sheet weighs 6.875 lbs. Find the weight of a sheet 48" x 132".

Solution:

Need to convert dimensions to feet and then compute surface area

$\frac{48 \text{ in}}{12 \text{ in/ft}} = 4$ feet

$\frac{132 \text{ in}}{12 \text{ in/ft}} = 11$ feet

LW = Area of a rectangle

(4 ft)(11 ft) = 44 sq ft

Now multiply the number of sq ft by the weight of one sq foot.

(44 sq ft)(6.875 lbs/sq ft) = 302.5 lbs

So the weight of the steel sheet is 302.5 lbs.

B. Problems without Solutions

3. Convert each of the following measurements to feet in decimals.

(a) 4' 6" (b) 6' 3"

(c) 2' 4 1/4" (d) 9' 10 5/8"

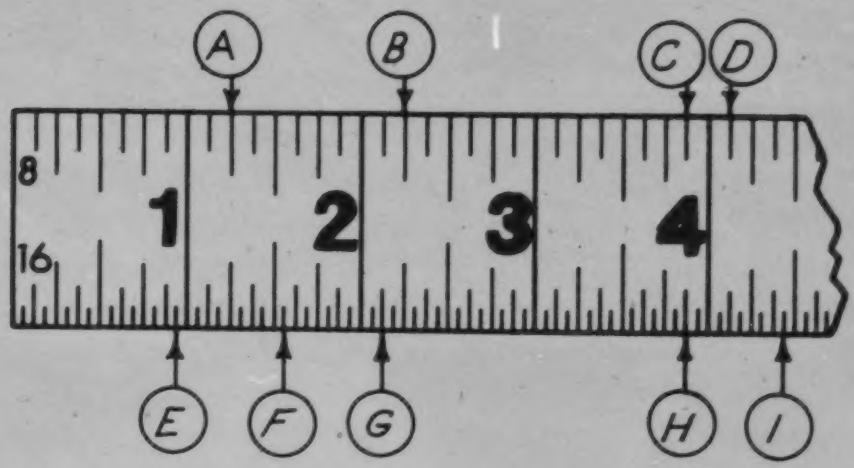
(e) 7" (f) 27"

(g) 103 1/2" (h) 1/4"

Solution:

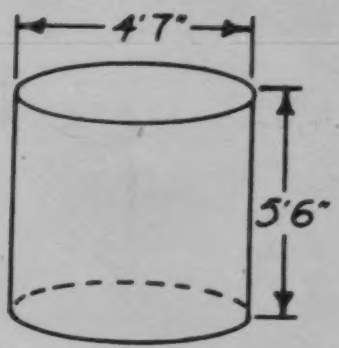
B. Problems without Solutions (continued)

4. Find the distance from the start of the ruler to each of the indicated positions.



Solution:

5. A closed holding tank of 14 gauge steel plate (3.125 lbs/sq ft) is to be constructed according to the given drawing. Find the weight of the tank.



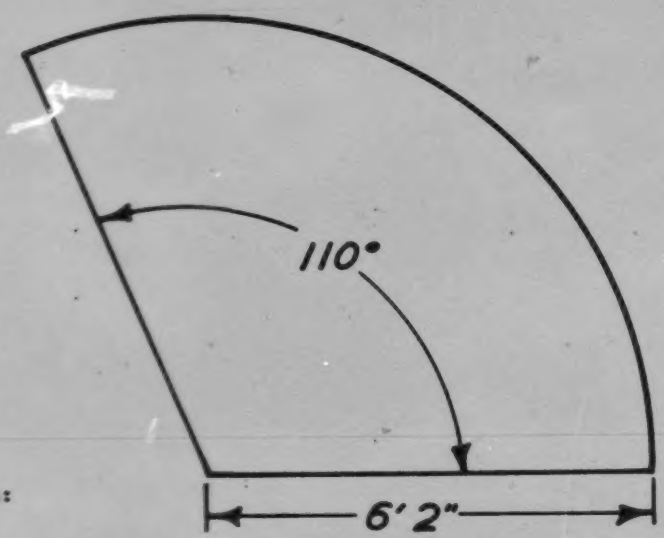
Solution:

B. Problems without Solutions (continued)

6. The circular top of a storage tank is to be constructed of 14 gauge hot rolled steel that weighs 3.125 lbs per square foot. If the radius of the top is to be 4' 10" find the weight of the top.

Solution:

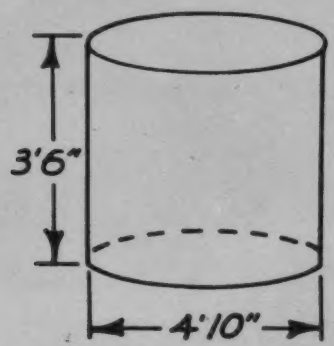
7. Find the weight of the sector of a circular plate of 12 gauge steel if the weight per square foot is 4.375 lbs.



Solution:

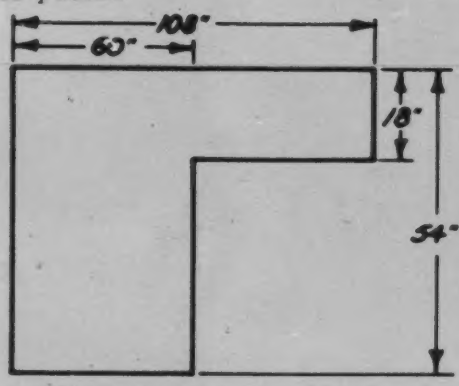
B. Problems without Solutions (continued)

8. Find the capacity in gallons of the given cylindrical fuel tank if one cubic foot contains 7.5 gallons of fuel oil.



Solution:

9. Find the cost of the pictured sheet of 18 gauge steel if the steel sells for $00.215 per pound.



18 gauge steel weighs 2.0 lbs per square foot

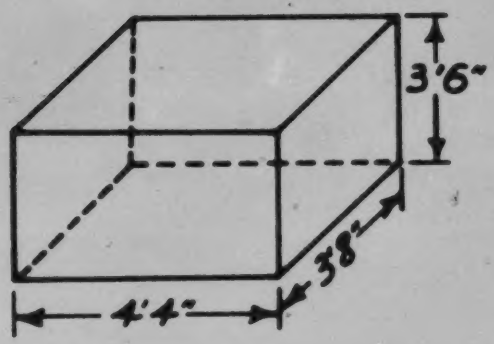
Solution:

B. Problems without Solutions (continued)

10. A closed holding tank, in the form of a rectangular solid, is to be constructed from 3/16" plate steel which weighs 8.125 lbs per square foot. If the tank is to be constructed according to the given diagram and steel sells for $0.185 per pound, find:

    (a) The cost of the steel.

    (b) The capacity of the tank if it is known that one cubic foot of water contains 7.5 gallons.



Solution:

Complete Solutions to B Problems

3. Need to divide the inches by 12. For practicability, all answers are rounded to nearest hundredth.

(a) 4' 6" = 4 6/12' = 4.5"

(b) 6' 3" = 6 3/12' = 6.25'

(c) 2' 4 1/4" = $2\ \frac{4\ 1/4'}{12} = 2\ \frac{17'}{48}$ = 2.35'

(d) 9' 10 5/8" = $9\ \frac{10\ 5/8'}{12} = 9\ \frac{85'}{96}$ = 9.89'

(e) 7" = 7/12' = .58'

(f) 27" = 27/12' = 2.25'

(g) 103 1/2" = $\frac{103\ 1/2'}{12} = \frac{207'}{24}$ = 8.63'

(h) 1/4" = $\frac{1/4'}{12} = \frac{1'}{48}$ = .02'

4. Need to determine the length indicated on the ruler.

(a) 1 2/8" or 1 1/4"

(b) 2 2/8" or 2 1/4"

(c) 3 7/8"

(d) 4 1/8"

(e) 15/16"

(f) 1 9/16"

(g) 2 2/16" or 2 1/8"

(h) 3 14/16" or 3 7/8"

(i) 4 7/16"

Complete Solutions to B Problems (continued)

5. Need to determine the total surface area, using the formula $S = 2\pi r h + 2\pi r^2$ and then multiply the surface area by the weight per square foot.

4 7/12' is approximately 4.583' and 5' 6" is 5.5'
$h = 5.5'$

$r = \frac{4.583'}{2} = 2.2915'$

$S = 2\pi r h + 2\pi r^2$
$= (2)(3.14)(2.2915')(5.5') + (2)(3.14)(2.2915')^2$
$= 79.148 + 32.976$
$= 112.12$ sq ft
Weight = (112.12 ~~sq ft~~)(3.125 lbs/~~sq ft~~)
= 350.375 lbs Therefore, the total weight is about 350 lbs

6. Need to compute the surface area of the top using $A = \pi r^2$ and then multiply by the weight per square foot.

$r = 4' 10" = 4\ 10/12' = 4\ 5/6' = 4.83'$
$A = \pi r^2$
$= (3.14)(4.83')^2$
$= (3.14)(23.3289)$
$= 73.25$ sq ft

Weight = (73.25 ~~sq ft~~)(3.125 lbs/~~sq ft~~)
= 228.9 So the weight is approximately 229 lbs

7. Need to determine what fractional(or decimal) part of a circle we have and then multiply that fraction (or decimal) by the area of the whole circle using A = fractional part times πr^2.

We can think of a circle as being made of 360 parts or degrees. Since we have 110 of these parts, the fractional part of this particular circle is 110/360

$110/360 = 11/36 = .31$
$r = 6' 2" = 6\ 2/12' = 6.17'$
$A = (.31)(3.14)(6.17')^2$
$= 37.06$ sq ft
Now we multiply the areas by the weight per sq ft
Weight = (37.06 ~~sq ft~~)(4.375 lbs/~~sq ft~~)
= 162.1375 lbs So the weight is about 162 lbs

Complete Solutions to B Problems (continued)

8. Need to find volume, in cubic feet, of the torch and then multiply by the number of gallons per cubic foot.

3' 6" = 3.5 feet
4' 10" = 4.83 feet
radius = 2' 5" = 2.417 feet
$V = \pi r^2 h$
$= (3.14)(2.417 \text{ ft})^2 (3.5 \text{ ft})$
$= 64.2$ cu ft

Since 1 cubic foot equals 7.5 gals, we have (64.2 ~~cu ft~~)(7.5 gals/~~cu ft~~). Therefore, the torch will hold about 481.5 gals.

9. Need to break the figure into two rectangles and determine the total square feet and then multiply by the weight per sq ft.

$A = LW$
60" = 5'
54" = 4.5'
$A_1 = (5')(4.5') = 22.5$ sq ft
108" - 60" = 48"
48" = 4 ft
18" = 1.5 ft
$A_2 = (4')(1.5') = 6$ sq ft
$A_1 + A_2 = 22.5 \text{ sq ft} + 6 \text{ sq ft}$
$= 28.5$ sq ft
(28.5 ~~sq ft~~)(2.0 lb/~~sq ft~~) = 57 lbs
So the total weight is 57 lbs.

10. (a) Need to determine the surface area and then multiply the result by the lbs per square foot

Surface area = 2(lw) + 2(lh) + 2(wh)
l = 4' 4" = 4 4/12' = 4 1/3'
w = 3' 8" = 3 8/12' = 3 2/3'
h = 3' 6" = 3 6/12' = 3 1/2'

Surface area = $2(4\ 1/3')(3\ 2/3') + 2(4\ 1/3')(3\ 1/2') + 2(3\ 2/3')(3\ 1/2')$
$= (2/1)(13/3)(11/3) + (2/1)(13/3)(7/2) + (2/1)(11/3)(7/2)$
$= (286/9) + (182/6) + (154/6)$
$= 572/18 + 546/18 + 462/18 = 1580/18 = 87.8$ sq ft
(87.8 ~~sq ft~~)(8.125 lb/~~sq ft~~) = 713.4 lbs rounded to 713 lbs
Cost = (713 lbs)($0.185) = $131.91

Complete Solutions to B Problems (continued)

10. (b) Need to find the volume of the tank and multiply the result by the number of gallons per cubic foot.

$V = l\,w\,h$

$= (4\ 1/3')(3\ 2/3')(3\ 1/2')$

$= (13/3)(11/3)(7/2)$

$= 1001/18 = 55.6$ cubic feet

$(55.6\ \text{cu ft})(7.5\ \text{gal/cu ft}) = 417.08$ gals

So the tank will hold about 417 gallons

A. Problems with solutions.

1. A Triplett multimeter on the 300 volt DC range has its scale divided into six major divisions, each of which is subdivided into five minor divisions, each of which, in turn, is divided into five increments. For the voltage readings below, locate the pointer in the scale by indicating which major division, minor division and increment the pointer has passed, using a fractional part of an increment if the pointer lies within an increment.

   A. 132 Volts DC
   B. 260 Volts DC
   C. 76 Volts DC
   D. 201.5 Volts DC

   Solution:

   300 V 6 major divisions = 50 V per major division

   50 V 5 minor divisions = 10 V per minor division

   10 V 5 increments = 2 V per increment

   A. 132 V DC = 2 major + 3 minor + 1 increment
   B. 260 V DC = 5 major + 1 minor + 0 increment
   C. 76 V DC = 1 major + 2 minor + 3 increments
   D. 201.5 V DC = 4 major+ 0 minor + 3/4 increment

B. Problems without solutions:

2. The units of resistance (Ω), capacitance (fd), inductance (hy) time (sec), power (W), current(A), voltage (V), frequency (Hz), and distance (English or metric units) vary over extreme ranges in electronics. Hence it is common to use prefixes to signify the insignificant digets of a quantity. Some of the common prefixes and their contribution to magnitude are:

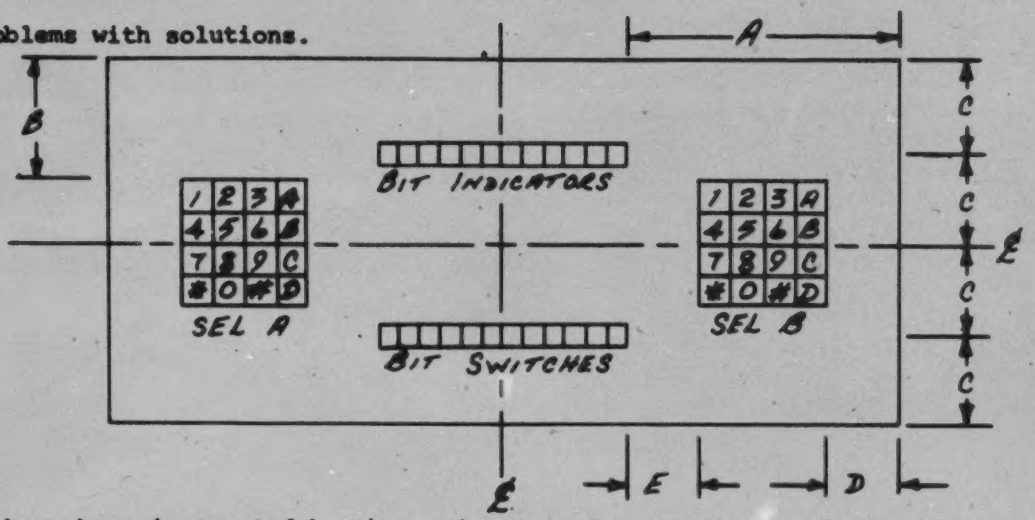
   Very large values : GIGA (G)= $X10^9$; MEGA (M) = $x10^6$; KILO (K) = $X10^3$
   Very small values ; NANO (η)= $x10^{-9}$; MICRO (μ)$^{-6}$= x10 ; MILLI (m) = $X10^{-3}$

   Convert the entries below by filling in the spaces. Use powers of 10 and do not move the decimal in the original entries.

GIGA	MEGA	KILO	UNITS	MILLI	MICRO	NANO
	16 M					
		300K Hz				
					10 μfd	
						5 η sec
				8m hv		
			600 Ω			

B. Problems with solutions.

3.



You have been instructed by the engineer to lay out the panel assembly above for use in a digital test unit. The parts data are as follows:

Panel --- Bud standard front panel 8 3/4" by 19"

Bit indicators--- Sylvania 12-light strip socket. Each indicator is 1/2" by 1/2" square.

Bit switches--- Raytheon MST toggle switches, 1/2" by 1/2" square

Sel A, Sel B--- Raytheon type EF 16-key switch array. Switchblock dimensions 3" by 3"

Lay out the panel and determine dimensions A,B,C,D,E. Check your results.

B. Problems without solutions.

4. In an intensive care unit the blood pressure of the patient is to be transmitted to the nurses' console where it is to be displayed in in millimeters of mercury. The only available precision transducer (pick-up device) has an output voltage which represents pounds per square inch (PSI). It is therefore necessary to install a scaling amplifier unit between the transducer and the blood pressure gauge at the console which is calibrated in mm of mercury per volt.

   Ignoring temperature effects, what would be the scale factor (gain) of the amplifier in order to make this conversion?

   Ref: I PSI = 2.035 inches of mercury
   I inch= 2.540 centimeters

Complete solutions to B problems.

2.

GIGA	MEGA	KILO	UNITS	MILLI	MICRO	NANO
16×10^{-3}	16MΩ	16×10^{3}	16×10^{6}	16×10^{9}	16×10^{12}	16×10^{15}
300×10^{-6}	300×10^{-3}	300KHz	300×10^{3}	300×10^{6}	300×10^{9}	300×10^{12}
10×10^{-15}	10×10^{-12}	10×10^{-9}	10×10^{-6}	10×10^{-3}	10 μfd	10×10^{3}
5×10^{-18}	5×10^{-15}	5×10^{-12}	5×10^{-9}	5×10^{-6}	5×10^{-3}	5 η sec
8×10^{-12}	8×10^{-9}	8×10^{-6}	8×10^{-3}	8 mhy	8×10^{3}	8×10^{6}
600×10^{-9}	600×10^{-6}	600×10^{-3}	600 Ω	600×10^{3}	600×10^{6}	600×10^{9}

3. The student will be required to lay out the panel to scale and use fractions to calculate and check his dimensions.

A = 6 1/2"

B = 2 7/8"

C = 2 3/16"

D = 1 3/4"

E = 1 3/4"

Checks

Sides:

4XC = 4x2 3/16 = 8 3/4"

2B+3 = 2 (2 7/8) + 3 = 8 3/4"

TOP & BOTTOM:

2D +2E + 6" +3" +3" =

2 (1 3/4) + 2 (1 3/4) + 12" = 19"

4. 1 inch = 2.540 Cm = 25.40 mm

I PSI = 2.035 inches of mercury x $\frac{25.40 \text{ mm}}{\text{inch}}$

I PSI = 51.69 mm of mercury

Scale Factor (gain) = 51.69 to 1

A. Problems with solutions.

1. Determine the number of tomato plants needed to fill 60 rows each 300 ft. long, when the plants are to be spaced 2 1/2 ft. apart.

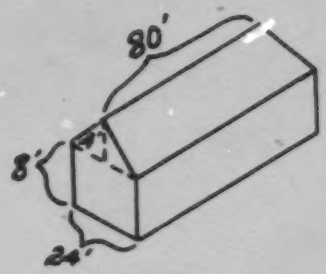
   Solution:

   Plants per row: $(300 \text{ ft.}) \left(\frac{1 \text{ plant}}{2\ 1/2 \text{ ft.}}\right) = 120$ plants

   Total plants : $\left(\frac{120 \text{ plants}}{\text{row}}\right)$ (60 rows) = 7,200 plants

2. Using an organic phosphate for the control of spiders at the rate of 1 lb./12,000 $ft.^3$, how many pounds will be needed for a glass house that is 80 ft. long, 24 ft. wide with 8 foot walls and a roof gable 4 ft. above the walls?

Solution:



Volume : cross section area x length

$\left[(24 \text{ ft.})\ (8 \text{ ft.}) + \left(\frac{1}{2}\right)\ (24 \text{ ft.})\ (4 \text{ ft.})\right](80 \text{ ft.})$

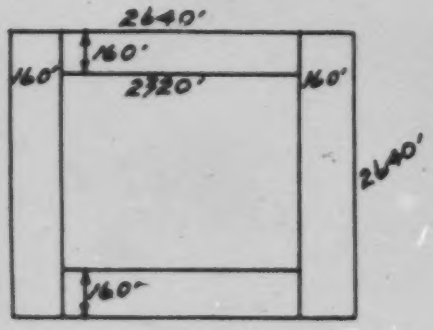
$= \left[(192 \text{ sq ft}) + (48 \text{ sq ft})\right](80 \text{ ft})$

$= (240 \text{ sq ft})\ (80 \text{ ft.}) = 19{,}200$ cu ft

amount of Phosphate : $(19{,}200 \text{ cu ft}) \left(\frac{1 \text{ lb}}{12{,}000}\right) = 1.5$ lbs.

3. Mr Jones has a square field that contains 160 acres, if he makes 10 trips around the field with a combine with a 16 ft. header, how many acres have been covered? (Assume a 5% overlap.)

Solution:
160 acres = 1/4 section (sq. miles), therefore 1/2 mile on each side.



$\left(\frac{1}{2}\right)$ (5,280 ft) = 2,640 ft.

(2,640 ft) (160 ft) (2) = 844,800 sq ft

(2,320 ft) (160 ft) (2) = 742,400 sq ft

1,587,200 sq ft

(1,587,200 sq ft) (.95) = (1,507,840 sq ft) $\left(\frac{1 \text{ acre}}{43{,}560 \text{ sq ft}}\right)$ = 34.6 acres

B. Problems without Solutions

4. Applying 0.3 lbs/100 sq ft, how many pounds of a complete fertilizer (Vigoro) would be needed to fertilize a lawn 106 ft by 94 ft assuming a house and walk take up 1,400 sq ft of the lot?

5. To provide a base for a concrete floor, a fill of sand averaging 1 1/4 ft deep is to be made in an implement shed that is 80 ft by 24 ft. How many cubic yards of sand will be needed?

6. At 270 rpm, how far does a point on the circumference of a 8 in pulley wheel travel in one hour?

7. A cylindrical grain storage bin is 15 feet in diameter and 20 feet high. If it is empty, how many minutes will it take to fill the bin if the auger delivers 20 bushels per minute?

B. Problems without solutions.

8. Calculate the cost to build a 4 rail fence 200 ft. long using 4x6's for posts 6 ft. long with 10 foot spacing and 2x6's for the rails. 2x6's cost 28¢ a board foot and 4x6's cost 36¢ a board foot.

9. The piston in a hydraulic lift has a diameter of 4 1/4 in. Find the number of pounds force available from a piston when operating with a pressure of 1,845 lbs/sq in.

10. At 12,400 gallons per minute, how long will it take to apply 2 inches of water to 200 acres?

B. Problems without solutions, continued.

11. If you have bales 1 ft x 18 inches x3 feet weighing 95 lbs., how many ton of hay and how large a storage area would you need for 800 head of cattle? (Assume you would feed 40 lbs. of hay/day/head from November 1 to March 20 th.)

12. In a calibration test of an 18 x 8 grain drill, 30 turns of the drive wheel yielded 6.4 lbs. of oats when set in notch 38. If the circumference of the wheel is 12.1 feet, how many bushels/acre are being sown when the drill is set in notch 38?

Complete solutions to B problems.

4. $\left[(106 \text{ ft})(94 \text{ ft.})\right] - 1{,}400 \text{ sq ft} = 9{,}964 \text{ sq ft.} - 1{,}400 \text{ sq ft} =$

$(8{,}564 \text{ sq ft}) \left(\frac{.3 \text{ lbs}}{100 \text{ sq ft}}\right) = 25.7 \text{ lbs.}$

5. Volume = (length) (width) (depth)

$\text{Volume} = (80 \text{ ft.})\ (24 \text{ ft.})\ (1\ 1/4 \text{ ft}) \left(\frac{1 \text{ cu yd}}{27 \text{ cu ft}}\right) = 88.9 \text{ cu yd}$

6. $\left(\frac{270 \text{ rev.}}{\text{min.}}\right) \left(\frac{(3.1416)(8 \text{ in.})}{\text{rev.}}\right) \left(\frac{60 \text{ min.}}{1 \text{ hour}}\right) \left(\frac{1 \text{ ft.}}{12 \text{ in.}}\right) \left(\frac{1 \text{ mile}}{5{,}280 \text{ ft.}}\right) = 6.426 \text{ miles.}$

7. $\text{Volume} = \frac{\pi D^2 h}{4} = \frac{(3.14 \text{ lbs.})\ (15 \text{ ft.})^2\ (20 \text{ ft.})}{4} = 3{,}534.3 \text{ cu ft.}$

$(3{,}534.3 \text{ cu ft}) \left(\frac{0.8036 \text{ bu}}{\text{cu ft}}\right) \left(\frac{\text{min}}{20 \text{ bu}}\right) = 142 \text{ min. or 2 hour 22 min.}$

8. Posts:

$\frac{200 \text{ ft.}}{\frac{10 \text{ ft.}}{\text{space}}} = 20 \text{ spaces, therefore } 21 \text{ posts}$

$\frac{(4")\ (6")(6')}{12} = \left(\frac{12 \text{ board feet}}{\text{post}}\right) (21 \text{ posts}) \left(\frac{36¢}{\text{board ft.}}\right) = \$90.72$

Rails:

$\frac{2" \times 6" \times 10'}{12} = \left(\frac{10 \text{ board feet}}{\text{board}}\right) \left(\frac{4 \text{ boards}}{\text{space}}\right) (20 \text{ spaces}) \left(\frac{28¢}{\text{bd/ft}}\right) = \$224.00$

Total = \$90.72 + \$224.00 = \$314.72

9. $\text{Area} = \frac{\pi D^2}{4} = \frac{(3.1416)\ (4\ 1/4 \text{ in.})^2}{4} = 14.19 \text{ sq in.}$

Force = (Pressure) (Area)

$\left(\frac{1{,}845 \text{ lbs.}}{\text{sq in.}}\right) (14.19 \text{ sq in.}) = 26{,}180.55 \text{ lbs}$

10. $\text{Volume} = (200 \text{ acres})(2 \text{ in}) \left(\frac{43{,}560 \text{ sq ft}}{1 \text{ acre}}\right) \left(\frac{1 \text{ ft.}}{12 \text{ in.}}\right) = 1{,}452{,}000 \text{ cu ft.}$

$(1{,}452{,}000 \text{ cu. ft.}) \left(\frac{7.5 \text{ gallons}}{\text{cu ft.}}\right) \div \frac{12{,}400 \text{ gal.}}{\text{minute}}$

$= (1{,}452{,}000 \text{ cu. ft.}) \left(\frac{7.5 \text{ gallons}}{\text{cu ft.}}\right) \left(\frac{1 \text{ minute}}{12{,}400 \text{ gal.}}\right) = 878 \text{ min. or 14 hr. 38 min.}$

Complete solutions to B problems, continued.

11. Days form Nov. 1st. to March 20 th = 30 Nov.
31 Dec.
31 Jan.
28 Feb.
20 Mar.

$$(800 \cancel{\text{head}})\ (140 \cancel{\text{days}})\left(\frac{40 \text{ lbs.}}{\cancel{\frac{\text{day}}{\text{head}}}}\right) = 4{,}480{,}000 \text{ lbs.}$$

$$(4{,}480{,}000 \cancel{\text{lbs.}})\left(\frac{1 \text{ ton}}{2{,}000 \cancel{\text{lbs.}}}\right) = 2{,}240 \text{ ton}$$

$$(1 \text{ foot})\ (18 \cancel{\text{inches}})\ (3 \text{ feet})\left(\frac{1 \text{ foot}}{12 \cancel{\text{inches}}}\right) = 4.5 \text{ cu ft.}$$

$$\left(\frac{4.5 \text{ ft}^3}{95 \cancel{\text{lbs.}}}\right)(4{,}480{,}00 \cancel{\text{lbs}}) = 212{,}210 \text{ cu ft}$$

12. Length = $\left(\frac{\text{circumference}}{\text{turn}}\right)$ (turns)

$$\left(\frac{12.1 \text{ ft}}{\cancel{\text{turn}}}\right)(30 \cancel{\text{turns}}) = 363 \text{ feet}$$

width = (No. of drops) (distance between drops)

$$(18)\ (8 \cancel{\text{inches}})\left(\frac{1 \text{ ft}}{12 \cancel{\text{inches}}}\right) = 12 \text{ feet}$$

area = (length) (width)

$$(363 \text{ ft})\ (12 \text{ ft}) = (4{,}356 \cancel{\text{sq ft}})\left(\frac{1 \text{ acre}}{43{,}560 \cancel{\text{sq ft}}}\right) = .1 \text{ acres}$$

$$\left(\frac{6.4 \cancel{\text{lbs.}}}{.1 \text{ acres}}\right)\left(\frac{1 \text{ bu.}}{32 \cancel{\text{lbs.}}}\right) = \frac{2 \text{ bu.}}{\text{acres.}}$$

Appendix

MEASUREMENT CONVERSIONS

To Convert	Into	Multiply by
Acre-feet	Gallons	325,900
Acres	Square chains (Gunter's)	10
Acres	Rods	160
Acres	Square links (Gunter's)	100,000
Acres	Hectares or square hectometers	.4047
Acres	Square feet	43,560
Acres	Square meters	4,047
Acres	Square yards	4,840
Ampere-hours	Coulombs	3,600
Ampere-hours	Faradays	0.03731
Angstrom units	Microns or (mu)	.0001
Barrels (U.S.,dry)	cubic inches	7056
Barrels (U.S.,dry)	Quarts (dry)	105
Barrels (U.S., liquid)	Gallons	31.5
Btu. (Brit. thermal units)	Gram-calories	252
Btu.	Horsepower-hours	.000391
Btu.	Joules	1,054.8
Btu.	Kilogram-calories	0.2520
Btu.	Kilogram-meters	107.5
Btu.	Kilowatt-hours	.0002298
Bushels	Cubic feet	1.2445
Bushels	Cubic inches	2,150.4
Bushels	Cubic meters	0.03524
Bushels	Liters	35.24
Bushels	Pecks	4
Bushels	Pints (dry)	64
Bushels	Quarts (dry)	32
Calories, gram (mean)	Btu. (mean)	.003969
Centigrade	Farenheit	$(C^{\circ} \times 9/5) + 32$

To Convert	Into	Multiply by
Centigrams	Grams	0.01
Centiliters	Cubic inches	.6103
Centiliters	Fluid ounces (U.S.)	.3382
Centimeters	Feet	.03281
Centimeters	Inches	0.3937
Centimeters	Kilometers	.00001
Centimeters	Meters	0.01
Centimeters	Miles	.0000062
Centimeters	Millimeters	10
Centimeters	Yards	.01094
Centimeters/second	Feet/minute	1.1969
Centimeters/second	Feet/second	0.03281
Centimeters/second	Kilometers/hour	0.036
Centimeters/second	Meters/minute	0.6
Centimeters/second	Miles/hour	0.02237
Centimeters/second	Miles/minute	.0003728
Chains	Inches	792
Chains	Meters	20.12
Chains (surveyor's or Gunter's)	Yards	22
Circumference	Radians	6.283
Cords	Cord feet	8
Cubic centimeters	Cubic Feet	.000035
Cubic centimeters	Cubic inches	.06102
Cubic centimeters	Cubic meters	.000001
Cubic centimeters	Cubic yards	.0000013
Cubic centimeters	Gallons (U.S.,liquid)	.000264
Cubic centimeters	Liters	0.001
Cubic centimeters	Pints (U.S.,liquid)	.002113
Cubic feet	Bushels (dry)	0.8036
Cubic Feet	Cubic centimeters	28,320
Cubic feet	Cubic inches	1,728
Cubic feet	Cubic meters	0.02832
Cubic feet	Cubic yards	0.03704
Cubic feet	Gallons (U.S., liquid)	7.48052
Cubic feet	Liters	28.32
Cubic feet	Pints (U.S., liquid)	59.84
Cubic Feet	Quarts (U.S., liquid)	29.92
Cubic feet/minute	Cubic centimeters/second	472
Cubic feet/minute	Gallons/second	0.1247
Cubic feet/minute	Liters/second	0.4720
Cubic feet/minute	Pounds of water/ minute	62.43
Cubic feet/second	Million gallons/day	0.646317
Cubic feet/second	Gallons/minute	448.831
Cubic inches	Cubic centimeters	16.39
Cubic inches	Cubic feet	.000579
Cubic inches	Cubic meters	.0000164
Cubic inches	Gallons	.004329
Cubic inches	Liters	0.01639

To Convert	Into	Multiply by
Cubic inches	Mil-feet	106100
Cubic inches	Pints (U.S.,liquid)	0.03463
Cubic inches	Quarts (U.S.,liquid)	0.01732
Cubic meters	Bushels (dry)	28.38
Cubic meters	Cubic centimeters	1,000,000
Cubic meters	Cubic feet	35.31
Cubic meters	Cubic inches	61,023
Cubic meters	Cubic yards	1,308
Cubic meters	Gallons (U.S.,liquid)	264.2
Cubic meters	Liters	1,000
Cubic meters	Pints (U.S., liquid)	2,113
Cubic meters	Quarts (U.S.,liquid)	1,057
Cubic yards	Cubic centimeters	764,600,000
Cubic yards	Cubic feet	27
Cubic yards	Cubic inches	46,656
Cubic yards	Cubic meters	0.7646
Cubic yards	Gallons (U.S.,liquid)	202
Cubic yards	Liters	764.6
Cubic yards	Pints (U.S.,Liquid)	1,615.9
Cubic yards	Quarts (U.S., liquid)	807.9
Degrees (angle)	Radians	0.01745
Degrees/second	Radians/second	0.01745
Degrees/second'	Revolutions/minute	0.1667
Degrees/second	Revolutions/second	.002778
Drams (apothecaries' or troy)	ounces (avoirdupois)	0.1371429
Drams	Grams	1.7718
Feet	Centimeters	30.48
Feet	Kilometers	.0003048
Feet	Meters	0.3048
Feet	Miles (naut.)	.0001645
Feet	Miles (stat.)	.0001894
Feet	Millimeters	304.8
Feet	Mils	12,000
Feet/minute	Feet/second	0.01667
Feet/minute	Kilometers/hour	0.01829
Feet/minute	Meters/minute	0.3048
Feet/minute	Miles/hour	0.01136
Feet/second	Centimeters/second	30.48
Feet/second	Kilometers/hour	1.097
Feet/second	Knots	0.5921
Feet/second	Meters/minute	18.29
Feet/second	Miles/hour	0.6818
Feet/ second	Miles/minute	0.01136
Foot-pounds	Btu.	.001286
Foot-pounds	Ergs	13,560,00
Foot-pounds	Gram-calories	0.3238
Foot-pounds	Horsepower-hours	.000000505
Furlongs	Feet	660

To Convert	Into	Multiply by
Furlongs	Miles (U.S.)	0.125
Foulongs	Rods	40
Gallons	Cubic centimeters	3,785
Gallons	Cubic feet	0.1337
Gallons	Cubic inches	231
Gallons	Cubic meters	.003785
Gallons	Cubic yards	.00495
Gallons	Liters	3.785
Gallons(Liq. Br. Imp.)	Gallons (U.S., liquid)	1.20095
Gallons (U.S.)	Gallons (Imp.)	0.83267
Gallons of water	Pounds of water	8.3453
Gallons/minute	Cubic feet/hour	8.0208
Gallons/minute	Cubic feet/ second	.002228
Gallons/minute	Liters/second	0.06308
Grams	Dynes	980.7
Grams	Grains	15.43
Grams	Joules/meter (newtons)	.0098
Grams	Kilograms	0.001
Grams	Milligrams	1,000
Grams	Ounces (avdp.)	0.03527
Grams	Ounces (troy)	0.03215
Grams	Poundals	0.07093
Grams	Pounds	.002205
Hands	Centimeters	10.16
Hectares	Acres	2.471
Hectares	Square feet	107,600
Hogsheads (U.S.)	Cubic feet	8.42184
Hogsheads (U.S.)	Gallons (U.S.)	63
Horsepower	Btu./,inute	42.44
Horsepower	Foot-pounds/minute	33,000
Horsepower	Food-pounds/second	550
Horsepower	Kilogram-calories/minute	10.68
Horsepower	Kilowatts	0.7457
Horsepower	Watts	745.7
Horsepower 550 ft.-lbs/sec.)	Horsepower (metric) (542.5 ft.-lbs./sec.)	1.014
Horsepower (metric) (542.5ft.-lbs.sec.)	Horsepower (550ft.-lbs. sec.)	0.9863
Hundredweights (long)	Pounds	112
Hundredweights (long)	Tons	0.05
Hundredweights (short)	Ounces (avdp.	1600
Hundredweights (short)	Pounds	100
Hundredweights (short)	Tons (long)	0.0446429

To Convert	Into	Multiply by
Hundredweights (short)	Tons (metric)	0.0453592
Inches	Centimeters	2.540
Inches	Meters	.0254
Inches	Miles	.00001578
Inches	Millimeters	25.40
Inches	Mils	1,000
Inches	Yards	.02778
Kilograms	Dynes	980,665
Kilograms	Grams	1,000
Kilograms	Pounds	2.205
Kilograms/meter	Pounds/foot	0.6720
Kilograms	Quintals	.01
Kilograms	Tons (long)	.000984
Kilograms	Tons (short)	.001102
Kilograms/square centimeter	Dynes	980,665
Kilometer	Inches	39,370
Kilometer	Meters	1,000
Kilometer	Miles	0.6214
Kilometer	Millimeters	1,000,000
Kilometer	Yards	1,094
Kilometer/hour	Feet/minute	54.68
Kilometer/hour	Feet/sceond	0.9113
Knots	Nautical miles/hour	1
Knots	Statute miles/hour	1.151
Leagues	Miles (approximate)	3
Light years	Kilometers	9,460,910,000,000
Light Years	Miles	5,900,000,000,000
Links (engineer's)	Inches	12
Links (surveyors)	Inches	7.92
Liters	Bushels (U.S.,dry)	0.02838
Liters	Cubic centimeters	1,000
Liters	Cubic feet	0.03531
Liters	Cubic inches	61.02
Liters	Cubic meters	0.001
Liters	Cubic yards	.00131
Liters	Gallons (U.S.,liquid)	0.2642
Liters	Pints (U.S., liquid)	2.113
Liters	Quarts (U.S., liquid)	1.057
Liters/minute	Cubic feet/second	.000589
Liters/minute	Gallons/second	.0044
Meters	Centimeters	100
Meters	Feet	3.281
Meters	Inches	39.37
Meters	Kilometers	0.001
Meters	Miles (nautical)	.0005396
Meters	Miles (statute)	.0006214
Meters	Millimeters	1,000

To Convert	Into	Multiply by
Meters	Varas	1.179
Meters	Yards	1.094
Meters/minute	Centimeters/second	1.667
Meters/minute	Feet/minute	3.281
Meters/minute	Feet/second	0.05468
Meters/minute	Kilometers/hour	0.06
Meters/minute	Knots	0.03238
Meters/minute	Miles/hour	0.03728
Meters/second	Feet/minute	196.8
Meters/second	Feet/second	3.281
Meters/second	Kilometers/hour	3.6
Meters/second	Kilometers/minute	0.06
Meters/second	Miles/hour	2.237
Meters/second	Miles/minute	0.03728
Microns	Meters	.000001
Miles/hour	Centimeters/second	44.70
Miles/hour	Feet/minute	88
Miles/hour	Feet/second	1,467
Miles/hour	Kilometers/hour	1.609
Miles/hour	Kilometers/minute	0.02682
Miles/hour	Knots	0.8684
Miles/hour	Meters/minute	26.82
Miles/hour	Miles/minute	0.1667
Miles/minute	Kilometers/minute	1.609
Miles/minute	Knots/minute	0.8684
Miles/minute	Miles/hour	60
Miles (nautical)	Feet	6,080.27
Miles (nautical)	Kilometers	1.853
Miles (nautical)	Meters	1,853
Miles (nautical)	Miles (statute)	1.1516
Miles (nautical)	Yards	2,027
Miles(statute)	Centimeters	160,900
Miles(statute)	Feet	5,280
Miles(statute)	inches	63,360
Miles(statute)	Kilometers	1.609
Miles(statute)	Meters	1,609
Miles(statute)	Miles (nautical)	0.8684
Miles(statute)	Yards	1,760
Millimeters	Centimeters	0.1
Millimeters	Feet	.003281
Millimeters	inches	0.03937
Millimeters	Kilometers	.000001
Millimeters	Meters	0.001
Millimeters	Miles	.0000006214
Millimeters	Mils	39.37
Millimeters	Yards	.001094
Mils	Inches	0.001
Ounces	Drams	16
Ounces	Grains	437.6

To Convert	Into	Multiply by
Ounces	Grams	28.349527
Ounces	Ounces (troy)	0.9115
Ounces	Pounds	0.0625
Ounces	Tons (long)	.0000279
Ounces	Tons (metric)	.00002835
Ounces (fluid)	Cubic inches	1.805
Ounces (fluid)	Liters	0.02957
Pecks (British)	Cubic inches	554.6
Pecks (British)	Liters	9.091901
Pecks (U.S.)	Bushels	0.25
Pecks (U.S.)	Cubic inches	537.605
Pecks (U.S.)	Liters	8.809582
Pecks (U.S.)	Quarts (dry)	8
Pints (dry)	Cubic inches	33.60
Pints (liquid)	Cubic centimeters	473.2
Pints (liquid)	Cubic feet	0.01671
Pints (liquid)	Cubic inches	28.87
Pints (liquid)	Cubic meters	.0004732
Pints (liquid)	Cubic yards	.0006189
Pints (liquid)	Gallons	0.125
Pints (liquid)	Liters	0.4732
Pints (liquid)	Quarts (liquid)	0.5
Pounds	Dynes	444,823
Pounds	Grains	7,000
Pounds	Grams	453.5924
Pounds	Joules/centimeter	0.04448
Pounds	Joules/meter (newtons)	4.448
Pounds	Kilograms	0.4536
Pounds	Ounces	16
Pounds	Ounces (troy)	14.5833
Quarts (dry)	Cubic inches	67.20
Quarts (liquid)	Cubic centimeters	946.4
Quarts (liquid)	Cubic feet	0.03342
Quarts (liquid)	Cubic inches	57.75
Quarts (liquid)	Cubic meters	.0009464
Quarts (liquid)	Cubic yards	.001238
Quarts (liquid)	Gallons	0.25
Quarts (liquid)	Liters	0.9463
Quintals	Kilometers	100
Radians	Degrees	57.30
Radians	Minutes	3,438
Revolutions	Degrees	360
Revolutions	Radians	6.283
Revolutions/minute	Degrees/second	6
Revolutions/minute	Radians/second	0.1047
Revolutions/minute	Revolutions/second	0.01667
Rods	Chains (Gunter's)	.25
Rods	Feet	16.5
Rods	Meters	5.029

To Convert	Into	Multiply by
Rods (surveyor"s measure	Yards	5.5
Square centimeters	Square foot	.001076
Square centimeters	Square inches	0.1550
Square centimeters	Square meters	0.0001
Square centimeters	Square yards	.0001196
Square feet	Acres	.00002296
Square feet	Square centimeters	929
Square feet	Square inches	144
Square feet	Square meters	0.09290
Square feet	Square miles	.00000003587
Square feet	Square millimeters	92,900
Square feet	Square yards	0.1111
Square inches	Circular mulls	1,273,000
Square inches	Square centimeters	6.452
Square inches	Square feet	.006944
Square inches	Square millimeters	645.2
Square inches	Square mils	1,000,000
Square inches	Square yards	.0007716
Square kilometers	Acres	247.1
Square kilometers	Square centimeters	10,000,000,000
Square kilometers	Square feet	10,760,000
Square kilometers	Square inches	1,550,000,000
Square kilometers	Square meters	1,000,000
Square kilometers	Square miles	0.3861
Square kilometers	Suqare yards	1,196,000
Square meters	Acres	.0002471
Square meters	Square centimeters	10,000
Square meters	Square feet	10.76
Square meters	Square inches	1550
Square meters	Square miles	.000000386
Square meters	Square millimeters	1,000,000
Square meters	Square yards	1.196
Square miles	Acres	640
Squarelmiles	Square feet	27,880,000
Square miles	Square Kilometers	2.590
Square miles	Square meters	2,590,000
Square miles	Square yards	3,098,000
Square millimeters	Circular mils	1,973
Square millimeters	Square centimeters	0.01
Square yards	Square acres	.0002066
Square yards	Square centimeter	8,361
Square yards	Square feet	9
Square yards	Square inches	1,296
Square yards	Square meters	0.8361
Temperature (°C.) + 273	Absolute temperature (°C.)	1

To convert	Into	Multiply by
Temperature °(C.) + 17.78	Temperature (°F.)	1.8
Temperature (°F.) + 460	Absolute temperature (°F.)	1
Temperature (°F.) -32	Temperature (°C.)	5/9
Tons (long)	Kilograms	1,016
Tons (long)	Pounds	2,240
Tons (long)	Tons (short)	1.120
Tons (metric)	Kilograms	1,000
Tons metric	Pounds	2,205
Tons (short)	Kilograms	907.1848
Tons (short)	Ounces	32,000
Tons (short)	Ounces (troy)	29,166.66
Tons (short)	Pounds	2,000
Yards	Centimeters	91.44
Yards	Kilometers	.0009144
Yards	Meters	0.9144
Yards	Miles (nautical)	.0004934
Yards	Miles (statute)	.0005682
Yards	Millimeters	914.4

A. Problems with Solutions

1. The discharge rate through a culvert was measured to be 1 cfs (1 cubic foot per second). At the end of a 24 hr period how many acre-feet (ac-ft) will have passed through the culvert?

   Solution:

$$\text{Number of acre-feet} = \frac{(1\ \text{cu ft/sec})(24\ \text{hr})(3600\ \text{sec/hr})}{43.560\ \text{cu ft/acre-ft}}$$

$$= 1.985\ \text{acre-ft}$$

2. How many ac-ft of storage is needed to supply 5" of irrigation for a 16 acre alfalfa field?

   Solution:

$$\text{Number of acre-ft} = (5/12\ \text{ft})(16\ \text{acre}) = 6.66\ \text{acre-ft}$$

3. How much time is required to pump 6.67 acre-ft at the rate of 250 gpm?

   Solution:

$$\text{Time required} = \frac{(6.67\ \text{acre-ft})(43{,}560\ \text{cu ft/ac-ft})(7.48\ \text{gal/cu ft})}{250\ \text{gal/min}}$$

$$= 8{,}693.11\ \text{min}$$
$$= 144.89\ \text{hr}$$

B. Problems without Solutions

4. What size (Hp rating) of pump would be required to deliver 16 gpm from a well that is 90 ft deep? Assume 100% efficiency. Work = (Force, lb)(Distance, ft)

B. Problems without Solutions (continued)

5. What size pump would be required to deliver water to an elevated storage tank that is 100 ft above the source? The rate of delivery equals 15 cfs. Assume 100% efficiency.

6. What is the horsepower capacity of an electric motor to drive the pump described below?

Pump must deliver water a vertical distance of 16 ft. This is the distance water must be lifted plus friction losses through the pump and piping. It is the practice in hydraulics to express pump entrance and discharge losses and friction losses in the pump as equal to a certain additional feet to lift the water. Pump will deliver 2800 gallons per minute. Efficiency of pump and motor, termed plant efficiency is 68%.

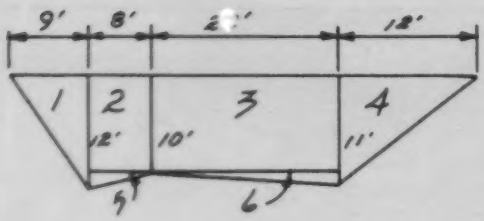
B. Problems without Solutions (continued)

7. Description:

The amount of water flowing in a stream (Q) is equal to the cross-sectional area of flowing water (A) multiplied by its mean velocity (V). Q = VA.
1 cu ft/sec = 646,317 gal/day
Rule of thumb -- 1 cfs = 2 acre-ft/day

Problem:

The mean velocity of Johnson Creek at peak flood stage was measured and is equal to 26.8 ft/sec. How many gal/day will pass this point?



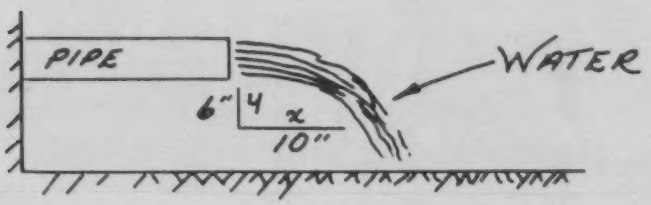
Cross-section of stream channel

B. Problems without Solutions (continued)

8. Description:

On the Scenic Highway, 2 miles west of Springdale, Oregon, there is a spring which the state is thinking of using as a water source for its new addition to Dabney Park.

Presently there is a 2" pipe that acts as an overflow. The discharge parameters are as indicated:



Problem:

Statistical data indicates a daily usage of 2200 people. Each user consumes approximately 2 gal of water per day. Is this spring a sufficient supply?

Assume 8 hour day. $Q = (2.83)(D)\frac{x}{\sqrt{y}}$

Q = discharge in gal/min
D = ID of pipe

B. Problems without Solutions (continued)

9. Each foot of length along a new road requires 20 cu ft of concrete, which a machine pours at the rate of 24 tons/hr. Find the length of road poured in an 8 hour day. Assume the concrete weighs 150 lbs/cu ft.

10. The thermal conductivity of steel is about 320 BTU-in/sq ft-hr-F°. What is the equivalent value in cal-cm/sq cm-sec-F°?

B. Problems without Solutions (continued)

11. A certain refrigeration machine requires 220 ft-lb of compressor work per BTU of heat removal. Convert this information to kilowatts of power required per ton of refrigeration. Heat removal is assumed to be 200 BTU/min/ton of refrigeration.

12. Two pumps are used to fill the same tank. If pump A can fill the tank in 4.2 hr and pump B can fill it in 9.7 hr, how long would it take if both pumps are used to fill the tank?

B. Problems without Solutions (continued)

13. A cable drum is rotating at 90 rpm. The drum surface turns through a distance of 5 ft/rev. How fast is the cable being wound onto the drum in in/sec?

14. A furnace consumes 500 lb of coal/hr. Assume there is 0.9 lb of carbon/lb of coal, and the carbon requires 3 lb of oxygen/lb of carbon. There is about 0.2 lb of oxygen/lb of air and 0.076 lb of air/cu ft of air. Find the amount of air required in cu ft/min.

Complete Solutions to B Problems

4. $W = (F)(D)$

$F = (16\ gal/min)(8.33\ lb/gal)$

$W = (16\ \cancel{gal}/min)(8.33\ lb/\cancel{gal})(90\ ft)$

$= 11{,}995.2\ ft\text{-}lb/min$

To convert ft-lb/min into horsepower, multiply by 0.0000303.

$W = (11{,}995.2\ ft\text{-}lb/min)(0.0000303) = 0.363\ hp$

5. $W = (F)(D)$

$F = (15\ \cancel{cu\ ft/sec})(7.48\ \cancel{gal}/\cancel{cu\ ft})(60\ \cancel{sec}/min)(8.33\ lb/\cancel{gal})$

$W = (15\ \cancel{cu\ ft}/\cancel{sec})(7.48\ \cancel{gal}/\cancel{cu\ ft})(60\ \cancel{sec}/min)(8.33\ lb/\cancel{gal})(100\ ft)$

$= 5{,}607{,}756\ ft\text{-}lb/min$

Change to horsepower

$W = (5{,}607{,}756\ ft\text{-}lb/min)(0.0000303) = 169.92\ hp$

6. $W = (F)(D)$

$F = (2800\ gal/min)(8.33\ lb/gal)$

$W = (2800\ \cancel{gal}/min)(8.33\ lb/\cancel{gal})(16\ ft)$

$= 373{,}184\ ft\text{-}lb/min$

Convert to horsepower

$W = (373{,}184\ ft\text{-}lb/min)(0.0000303) = 11.31\ hp$

11.31 hp is 68% of the hp required, so

$$hp\ required = \frac{11.31\ hp}{0.68} = 16.6\ hp$$

7. Divide the cross-sections into rectangles, and then find the area in sq ft of each section.

$A_1 = (1/2)(12')(9') = 54\ sq\ ft$

$A_2 = (10')(8') = 80\ sq\ ft$

$A_3 = (22')(10') = 220\ sq\ ft$

$A_4 = (1/2)(11')(12') = 66\ sq\ ft$

$A_5 = (1/2)(8')(2') = 8\ sq\ ft$

$A_6 = (1/2)(22')(1') = 11\ sq\ ft$

A = Total area = 439 sq ft

Complete Solutions to B Problems (continued)

7. (continued)

$Q = VA = (26.8 \text{ ft/sec})(439 \text{ sq ft}) = 11{,}765.2 \text{ cu ft/sec}$

To convert to gals/day, multiply by 646,316.6

$Q = (11{,}765.2 \text{ cu ft/sec})(646{,}316.6)$
$= 7{,}604{,}044{,}533 \text{ gal/day}$

8. $Q = (2.83)(D)\left(\frac{x}{\sqrt{y}}\right)$

$= (2.83)(2)\ \frac{10}{\sqrt{6}}$

$= 23.11 \text{ gal/min}$

Amount needed = (2,200)(2 gals/day) = 4,400 gals/day

Discharge = (23.11 gal/~~min~~)(60 ~~min/hr~~)(8 ~~hr~~/day)
= 11,092.8 gal/day

There is plenty of water.

9. (8 ~~hrs~~)(24 tons/~~hr~~) = 192 tons

$\frac{(192 \text{ ~~tons~~})(2{,}000 \text{ ~~lb~~/ton})}{150 \text{ ~~lb~~/cu ft}} = 2{,}560 \text{ cu ft}$

$\frac{2{,}560 \text{ ~~cu ft~~}}{20 \text{ ~~cu ft~~/ft}} = 128 \text{ feet of road in an 8 hour day}$

10. 1 BTU = 251.98 calories
1 in = 2.54 cm
1 sq ft = 929.0 sq cm
1 hr = 3,600 sec
°C = °F - 32

$\frac{(320 \text{ ~~BTU-in~~/~~sq ft-hr~~-°F})(251.98 \text{ cal/~~BTU~~})(2.54 \text{ cm/~~in~~})}{(929 \text{ sq cm/~~sq ft~~})(3.600 \text{ sec/~~hr~~})} = 0.06124 \text{ cal-cm/sq cm-sec- F}^{\bullet}$

Complete Solutions to B Problems (continued)

11. $$\frac{(220\ \text{ft-lbs/BTU})(200\ \text{BTU/min-ton})}{\frac{0.0000226\ \text{ft-lbs/min}}{1\ \text{KW}}} = 1{,}946{,}902{,}655\ \text{KW/ton}$$

12. 1/4.2 filling/hr + 1/9.7 filling/hr = 0.34 filling/hr

$$\frac{1}{0.34\ \text{filling/hr}} = 2.93\ \text{hr/filling}$$

13. (90 rev/min)(5 ft/rev)(12 in/ft)(1 min/60 sec) = 90 in/sec

14. (500 lb coal/hr)(0.9 lb carbon/lb coal) = 450 lb carbon/hr

(450 lb carbon/hr)(3 lb oxygen/lb carbon) = 1,350 lb oxygen/hr

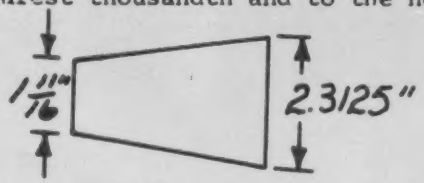
(1350 lb oxygen/hr)(1 lb air/0.2 lb oxygen) = 6750 lb air/hr

(6750 lb air/hr)(1 cu ft air/0.076 lb air) = 88,815.79 cu ft air/hr

(88,815.79 cu ft air/hr)(1 hr/60 min) = 1,480.26 cu ft air/min

A. Problems with Solutions

1. Find the differences in the diameters of the tapered pin shown. Give the answer to the nearest thousandth and to the nearest eighth of an inch.



Solution:

1 11/16" = 1.6875"

Differences in diameter = 2.3125" - 1.6875" = 0.625 in = 5/8 in

2. A shaft whose diameter is 3/4" is to be turned down on one end to a diameter of 0.576". How many thousandths of an inch should be lathed from the shaft?

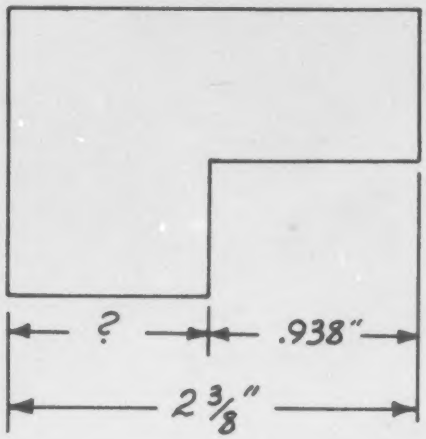
Solution:

3/4" = 0.75"

Shaft should be turned 0.75" - 0.576" = 0.174 in

B. Problems without Solutions

3. What is the missing dimension to the nearest sixteenth of an inch?



B. Problems without Solutions (continued)

4. If 8 pieces of stock each 18 cm long with 1 cm waste each are cut from a 29 ft bar, what length is left in feet and inches?

5. What is the radius in cm of a pulley whose diameter is 374 mm?

6. A piece of work must be turned to a diameter of 43 mm. Allowing at least 1/16" excess diameter for turning, what is the smallest diameter stock that can be used if stock on hand is in even sixteenths?

B. Problems without Solutions (continued)

7. An inventory sheet shows the following lengths of 1/4" rebar. How many feet of rebar are recorded on the inventory sheet?

   Lengths: 12' 6", 12' 9", 5' 6 3/4", 9' 5 1/4", 11' 4", 15' 4 1/2", 8' 9 1/2", 3' 4"

8. A piece of steel 5 1/2 feet long is cut into two parts by a power hacksaw. Extreme accuracy is required. A mark is placed 2' 9" from one end of the steel. The saw makes a cut 0.012" wide. Care is taken to insure that the cut is made on the center of the mark. How long will each remaining piece be?

9. Lubricating oil was used as follows: Jan, 3 1/2 qts; Feb, 3 1/4 qts; March, 6 qts; April, 5 3/4 qts; May, 3 3/4 qts; June, 5 1/2 qts. How many gallons of oil were used all together?

B. Problems without Solutions (continued)

10. A gallon of oil has a volume of 231 cubic inches. If a tank holds 420 gallons, what is the volume of the tank in cubic feet?

11. A tank holding 350 gal has two pipes connected to it; one empties 2 quarts in 5 seconds and the other 17 gal/min. How long will it take to empty the tank with both pipes flowing?

Complete Solutions to B Problems

3. Missing dimension = 2 3/8" - 0.938" = 2.375" - 0.938"

= 1.437 in

= 1 7/16 in

4. Total length cut = 8(18 cm) + 8(1 cm)

= 144 cm + 8 cm

= 152 cm

1 in = 2.54 cm

$(152 \text{ cm}) \left(\frac{1 \text{ in}}{2.54 \text{ cm}}\right) = 59.8 \text{ in}$

$(59.8 \text{ in}) \left(\frac{1 \text{ ft}}{12 \text{ in}}\right) = 4.98 \text{ ft}$

Length left = 29 ft - 59.8 in = 29 ft - 4.98 ft

= 24.02 ft

= 24 ft 0.24 in

= 24 ft 1/4 in

5. 1 mm = 0.1 cm

$(374 \text{ mm}) \left(\frac{0.1 \text{ cm}}{1 \text{ mm}}\right) = 37.4 \text{ cm}$ Radius = $\frac{37.4 \text{ cm}}{2} = 18.7 \text{ cm}$

6. 1 in = 2.54 cm so 1 in = 25.4 mm

$(43 \text{ mm}) \left(\frac{1 \text{ in}}{25.4 \text{ mm}}\right) = 1.69 \text{ in}$

Diameter needed = 1.69 in + 1/16 in

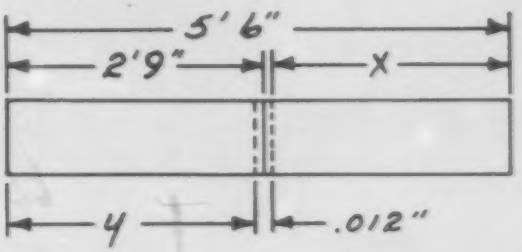
= 1.69 in + 0.0625 in

= 1.7525 in

The nearest diameter in whole sixteenths of an inch is 1 13/16"

7. Feet on inventory sheet = 12' 6" + 12' 9" + 3' 4" + 5' 6 3/4"
+ 9' 5 1/4" + 11' 4" + 15' 4 1/2" +
9' 9 1/2"
= 75' 49"
= 75' + 4' 1"
= 79 ft 1 in

8. y = 2' 9" - 1/2(0.012")
y = 2 ft 8.994 in
x = 5' 6" - 2' 9" - 1/2(0.012")
x = 2' 9" - 0.006"
x = 2 ft 8.994 in



9. Total oil used = 3 1/2 qts + 3 1/4 qts + 6 qts + 5 3/4 qts
+ 3 3/4 qts + 5 1/2 qts
= 27 3/4 qts

$$(27.75 \text{ qts})\left(\frac{1 \text{ gal}}{4 \text{ qts}}\right) = 6.9375 \text{ gals}$$

10. First convert 420 gallons to cubic inches

$$(420 \text{ gals})\left(\frac{231 \text{ cu in}}{1 \text{ gal}}\right) = 97{,}020 \text{ cu in}$$

Now convert cubic inches to cubic feet

$$(97{,}020 \text{ cu in})\left(\frac{1 \text{ cu ft}}{1{,}728 \text{ cu in}}\right) = 56.1 \text{ cu ft}$$

Complete Solutions to B Problems (continued)

11. Convert 2 qts in 5 sec to gal per min

$$\frac{2 \text{ qts}}{5 \text{ sec}} = 0.4 \text{ qts/sec}$$

$$(0.4 \text{ ~~qts/sec~~})(60 \text{ ~~sec~~/min})\left(\frac{1 \text{ gal}}{4 \text{ ~~qts~~}}\right) = 6 \text{ gal/min}$$

Total flow = 6 gal/min + 17 gal/min = 23 gal/min

$$\text{Time to fill the tank} = \frac{350 \text{ ~~gal~~}}{23 \text{ ~~gal~~/min}} = 15.2 \text{ min}$$

A. Problems with solutions.

1. How do you convert grams to grains?

Since there are 15.43 grams in a grain, you have to multiply by 15.43. To convert something from grains back to grams, you only need to divide by 15.43.

2. 0.25 gm = _____ mg.

There are 1000 milligrams (mg) in a gram (gm), so just multiply by 1000.

(0.25)(1000) = 250 mg.

3. M X = _____ drams.

M X stands for 10 minims, X being the Roman numeral for 10. A minim is equivalent to 0.06 ml. Since 1 dram equals 4 ml,

$$(10 \text{ minims})\left(\frac{0.06 \text{ ml}}{\text{minim}}\right)\left(\frac{1 \text{ dram}}{4 \text{ ml}}\right) = 0.15 \text{ dram}$$

B. Problems without solutions.

4. 12 gm = gr_____

5. gr lss = _____ Gm

6. 1 tsp. = M_____

B. Problems without solutions.

7. 16 cc = _____ drams.

8. 0.5 gm = _____ mg.

9. gr viiss = _____ gm = _____ mg

10. M XV = _____cc

11. 2000 cc = _____ quarts.

B. Problems without solutions.

12. 0.1 gm = gr _____

13. gr LXXV = _____Gm

14. 1 1/2 pints = _____ cc

15. 1 pint = _____ cc

16. 1 cc = M_____

17. Morphine gr 1/6 = _____ mg.

18. Atropine gr 1/150 = _____ mg

19. Thiamine gr 1/40 = _____ mg

B. Problems without solutions.

20. gr 1/500 = _____ mg

21. 1/2 ounce = _____ cc

22. M xxx = _____ cc

23. 30 cc = _____ tbsp.

24. 4 ml = _____ tsp.

25. 5000 cc = _____ L.

26. 30 mg = gr _____

27. 500 mg = _____ Gm

28. 100 mg = _____ Gm

29. 0.1 mg = _____ Gm

B. Problems without solutions.

30. 0.03 Gm = _____ mg.

31. 0.65 Gm = _____ mg.

32. 0.0025 Gm = _____ mg.

33. 1.2 Gm = _____ mg.

34. 250 mg = _____ Gm

35. 2 mg = _____ Gm

36. 60 mg = _____ Gm

37. Match each of the following with its closest equivalent. Place the number of the answer beside the letter of the question.

a. gr 1/4	1. 60 mg.
b. 10 mg.	2. 0.5 gm.
c. 1 fl. ounce	3. 4 ml.
d. 500 mg.	4. gr 1/8
e. 1 gm	5. 100 mg
f. gr 1	6. gr XV
g. 8 mg	7. 15 mg
h. 1 ml	8. 15 M
i. 1 dram	9. gr 1/6
j. gr iss	10. 1000 ml
k. 0.4 mg	11. gr 1/150
l. 1 liter	12. 30 cc

38. Convert the following:

	Fraction	=	Decimal	=	Percent
a.	1/3	=	_____	=	_____
b.	_____	=	.45	=	_____
c.	_____	=	_____	=	25%
d.	_____	=	2.5	=	_____

Complete solutions to B problems.

4. (12 ~~gm~~)(15.43 gr/~~gm~~) = 185.16 gr

5. lss is 1 1/2 in Apothecary jargon.

   15 gr = 1 gm

   (1.5 ~~gr~~)(1gm/15 ~~gr~~) = 0.10 gm

6. 1 tsp. = 4 ml

   1 ml = 15 minims

   (1 ~~tsp.~~) (4 ml/~~tsp~~) (15 minims/1 ~~ml~~) = 60 minims

7. 1 cc = 1 ml

   1 ml = 0.25 drams

   (16 ~~cc~~)(1 ~~ml~~/1 ~~cc~~) (0.25 drams/ 1 ~~ml~~) = 4.00 drams

8. (0.5 ~~gm~~)(1,000 mg/~~gm~~) = 500 mg

9. gr viiss = (0.5 ~~gm~~)(1000 mg/~~gm~~) = 500 mg

10. M XV = 15 minims

    1 minim = 0.06 ml

    1 ml = 1 cc

    (15 ~~minims~~)(0.06 ~~ml~~/ ~~minim~~)(1 cc/1 ~~ml~~) = 0.90 cc

11. $(2000\ \text{cc})\left(\frac{1.057 \times 10^{-3}\ \text{qts}}{\text{cc}}\right) = 2.11\ \text{qts.}$

12. 1 gm = 15 gr

    $\frac{1\ \text{gm}}{10} = \frac{15\ \text{gr}}{10}$

    0.1 gm = 1.5 gr

13. gr LXXV = 75 gr

    1 gr = 0.06 gm

    (75 ~~gr~~) (0.06 gm/ 1 ~~gr~~) = 4.5

Complete solutions to B problems.

14. 1 pt. = 500 ml

    1.5 pt = (1.5)(500ml)

    = 750 ml

    1 ml = 1 cc

    1.5 pt = 750 cc

15. 1 pt = 500 ml

    1 ml = 1 cc

    500 ml = 500 cc

16. 1 cc = 1 ml

    1 ml = 15 minims

17. 1/6 gr = 0.01 gm = 10 mg

18. 1/150 gr = 0.0004 gm = 0.4 mg

19. 1/40 gr = 0.0015 gm = 1.5 mg

20. 1/500 gr = 0.0012 gm = 0.12 mg

21. 1 fl. ounce = 30 ml

    1/2 fl. ounce = 15 ml.

    1 ml = 1 cc

    1/2 f. ounce = 15 cc

22. 30 minims = 2 ml

    1 ml = 1 cc

    2 ml = 2 cc

23. 1 tbs = 1/2 oz = 4 dr = 15 ml = 15 cc

    30 cc = 30 ml = 8 dr = 1 oz. = 2 tbsp.

Complete solutions to B problems.

24. 4 ml = 1 dram = 1 tsp.

25. 1 cc = 1 ml

5000 cc = 5000 ml

1 = 1000 ml

5000 ml = 5

26. 60 mg = 1 gr

30 mg = 0.5 gr

27. 1000 mg = 1 gm

500 mg = 0.5 gm

28. $\frac{1 \text{ gm}}{1000 \text{ mg}} = \frac{x \text{ gm}}{100 \text{ mg}}$

$\frac{(100 \text{ mg})(1 \text{ gm})}{1000 \text{ mg}} = x \text{ gm}$

$x = 0.10 \text{ gm}$

29. $\frac{1 \text{ gm}}{1000 \text{ mg}} = \frac{x \text{ gm}}{0.1 \text{ mg}}$

$\frac{(0.1 \text{ mg})(1 \text{ gm})}{6000 \text{ mg}} = x$

$x = 0.0001 \text{ gm}$

30. $\frac{1 \text{ mg}}{0.001 \text{ gm}} = \frac{x \text{ mg}}{0.03 \text{ gm}}$

$x = \frac{(1 \text{ mg})(0.03 \text{ gm})}{0.001 \text{ gm}}$

$= 30 \text{ mg}$

31. $\frac{1 \text{ mg}}{0.001 \text{ gm}} = \frac{x \text{ mg}}{0.65 \text{ gm}}$

$x = \frac{(1 \text{ mg})(0.65 \text{ gm})}{0.001 \text{ gm}}$

$= 650 \text{ mg}$

Complete solutions to B problems.

32. 1 gm = 1000 mg

$$\frac{1000 \text{ mg}}{1 \text{ gm}} = \frac{x \text{ mg}}{0.025 \text{ gm}}$$

$$x = \frac{(1000 \text{ mg})\ (0.025 \text{ gm})}{1 \text{ gm}}$$

$$= 2.5 \text{ mg}$$

33. 1 gm = 1000 mg

$$\frac{1000 \text{ mg}}{1 \text{ gm}} = \frac{x \text{ mg}}{1.2 \text{ gm}}$$

$$x = \frac{(1000 \text{ mg})(1.2 \text{ gm})}{1 \text{ gm}}$$

$$= 1{,}200 \text{ mg}$$

34. $\frac{1 \text{ gm}}{1000 \text{ mg}} = \frac{x \text{ gm}}{250 \text{ mg}}$

$$x = \frac{(250 \text{ mg})(1 \text{ gm})}{1000 \text{ mg}}$$

$$= 0.250 \text{ gm}$$

35. $\frac{1 \text{ gm}}{1000 \text{ mg}} = \frac{x \text{ gm}}{2 \text{ mg}}$

$$x = \frac{(2 \text{ mg})(1 \text{ gm})}{1000 \text{ mg}}$$

$$= 0.002 \text{ gm}$$

36. $\frac{1 \text{ gm}}{1000 \text{ mg}} = \frac{x \text{ gm}}{60 \text{ mg}}$

$$x = \frac{(60 \text{ mg})(1 \text{ gm})}{1000 \text{ mg}}$$

$$= 0.06 \text{ gm}$$

37.

a) 7	e) 5	i) 3
b) 9	f) 1	j) 5
c) 12	g) 4	k) 11
d) 2	h) 8	l) 10

38.

Fraction	Decimal	Percent
1/3	.333	33 1/3%
9/20	.45	45%
1/4	.25	25%
2 1/2 or 5/2	2.5	250%

The following conversion table is frequently expected to be memorized. Again, note the approximations. For instance, some charts show 16 = 1 cc and others, 15 = 1 cc. Nurses are usually instructed to use whichever value is the most convenient --- arithmetic-wise.

WEIGHT	VOLUME
Metric System	
1000 mg. = 1 gm	1 cc = 1 ml
1 kg = 1000 gm	1000 cc = 1 L
	1 cc = 1.057×10 qts.
Apothecary System	
1 dram = 60 grain	60 minim = 1 fl dr
12 oz = 1 lb	1 fl oz = 8 fl dr
8 dr = 1 oz	16 fl oz = 1 pint

Household	Apothecary	Metric
VOLUME:		
1 teaspoon	= 1 dram	= 4 ml
2 tbs	= 1 0z = 8 dr	= 30 ml
1 teacup	= 6 oz	= I80 ml
1 glassfull	= 8 oz	= 240 ml
	16 minim	= 1 cc
	30 cc	= 1 oz
	500 cc (473)	= 1 pint
	1000 cc (946)	= 1 qt.
WEIGHT:		
	1 grain	= 60 mg
	15 grain	= 1 gm
	1 oz	= 30 gm
	2.2 lb	= 1 kg

Apothecary System to Metric System (Weight)

gr	xv	=	1.0	gm	= 1000mg
gr	x	=	0.6	gm	= 600mg
gr	viiss	=	0.5	gm	= 500mg
gr	v	=	0.3	gm	= 300mg
gr	ii	=	0.2	gm	= 200mg
gr	1-1/2	=	0.1	gm	= 100mg
gr	1	=	0.06	gm	= 60mg
gr	3/4	=	0.05	gm	= 50mg
gr	1/2	=	0.03	gm	= 30mg
gr	1/4	=	0.015	gm	= 15mg
gr	1/6	=	0.010	gm	= 10mg
gr	1/8	=	0.008	gm	= 8mg
gr	1/12	=	0.005	gm	= 5mg
gr	1/15	=	0.004	gm	= 4mg
gr	1/20	=	0.0032	gm	= 3mg
gr	1/30	=	0.0022	gm	= 2mg
gr	1/40	=	0.0015	gm	= 1.5mg
gr	1/50	=	0.0012	gm	= 1.2mg
gr	1/60	=	0.001	gm	= 0.1mg
gr	1/100	=	0.0006	gm	= 0.6mg
gr	1/120	=	0.0005	gm	= 0.5mg
gr	1/150	=	0.0004	gm	= 0.4mg
gr	1/200	=	0.0003	gm	= 0.3mg
gr	1/300	=	0.0002	gm	= 0.2mg
gr	1/600	=	0.0001	gm	= 0.1mg